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The Fauna and Geography

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Maldive and Laccadive Archipelagoes

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The Fauna and Geography of the Maldive and Laccadive Archipelagoes

Being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900

Edited by

J. STANLEY GARDINER, M.A.

Fellow of Gonville and Caius College and late Balfour Student of the University of Cambridge.

VOLUME II AND SUPPLEMENTS I AND II.

With Plates XXVI—C, Text-Illustrations 120—154 and Index I and II.

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THE ALCYONARIA OF THE MALDIVES.

PART I.

THE GENERA XENIA, TELESTO, SPONGODES, NEPHTHYA, PARASPONGODES, CHIRONEPHTHYA, SIPHONOGORGIA, SOLENOCAULON, AND MELITODES.

By Sydney J. Hickson, M.A., D.Sc., F.R.S., *Beyer Professor of Zoology in the Owens College, Manchester.*

(With Plates XXVI and XXVII.)

INTRODUCTION.

This collection of Alcyonaria from the Maldive archipelago is of more than ordinary interest. In most cases the species of Alcyonaria have been founded on a single specimen obtained from a single dredging or on two or three specimens obtained from a single locality. The interest of the present collection lies in the fact that specimens were obtained from a considerable number of dredgings made in several of the atolls or off the reefs of a very extensive archipelago, and consequently an opportunity is afforded for the study of the variation of form, colour, and other features within the limits of a wide area. I have no hesitation in saying that the general impression gained by the study of single specimens of the different genera from a reef is usually an erroneous one, because it cannot give due weight to the important facts of the possible variations of a species living in surroundings and under conditions which are, within certain limits, identical. If we were to take at random, for example, a specimen of *Tubipora* from the reef off N. Celebes, and compare it with another specimen taken at random from the reef at Ternate, it is probable that so many differences would be found in the shape of the colony, the size of the tubes, the distance of the platforms, etc. in the two specimens that it would be thought necessary to make two species, one for the Celebes specimen and one for the Ternate specimen; but anyone who walks along the N. Celebes reefs at low tide will find in one morning not only the reputed Ternate species but a complete series leading from that up to the reputed Celebes species, and beyond it.

When I went out to Celebes the first thing I did was to collect specimens of *Tubipora,* having already obtained a knowledge of the genus in Europe from books and museums, but the conclusion I came to was that there is only one species which varies on the one reef within limits almost as wide as the limits of all the hitherto described species of the genus.

The collection made by Mr Gardiner in the Maldives affords an opportunity of judging of the extent of variation possible in one group of islands of some other genera that are widely distributed.

In the case of the genera *Spongodes* and *Solenocaulon*, for example, it is clear that there is a very great range of variation in form, colour, and in the size and shape of the spicules. They exhibit a number of "facies" which form an almost uninterrupted series between the types that have been described as distinct species. Now these facies are not confined to any one island of the Maldive archipelago, nor are they clearly separated from similar facies found in other parts of the tropical Indian and Pacific Oceans. If each facies represents a distinct species, then we have the very remarkable phenomenon of a large number of closely related species distributed over a very wide geographical area and competing in the struggle for existence, with approximately equal success, in many localities of this wide area. If, on the other hand, all the facies together represent but one species, then we have an example of a species that is capable of an extraordinary range of variation in circumstances which are approximately identical.

As it is impossible to prove either one of these propositions without recourse to experiments in cross breeding, the only course to pursue, as a temporary measure, is to place in a separate species those facies which appear to be discontinuous with others in their form and distribution, and to collect into one species those facies that are connected by sufficiently continuous series of intermediate links.

This is the course I have adopted in this paper.

As an example of the method I may refer to the genus *Solenocaulon*, in which we have no less than eight specimens from different islands of the Maldive archipelago connected together to form a series, and one specimen which I have called *S. ramosa* distinguished from them in the tube-formation of the stem, the retractility of the polyps and other characters. This last I regard as a distinct species at present, but I think it is quite possible that a series of intermediate forms between it and *S. tortuosum* may be found which will ultimately necessitate the abandonment of the specific name.

It is a question of very great importance as bearing upon the species problem, whether the varying forms and colours of these Alcyonarians are due to sporadic variation irrespective of their environment or to distinct inherited characters.

If we were to trace the history of 20 eggs of a brown divaricate *Spongodes* fertilised by the spermatozoa of another brown divaricate *Spongodes*, and settled down within a restricted area of a single reef, should we expect to find that all the young *Spongodes* developed from them were brown divaricates (*BD*), or should we expect to find that some of them were red conglomerates (*RC*), others yellow flabellates (*YF*), etc.? If they are all *BD*, with of course variations in minor particulars, then we should be justified in believing that the brown colour and the divaricate manner of branching are not only transmissible by inheritance, but are so transmitted because they are of some importance to the species in the struggle for existence. If on the other hand the young *Spongodes* are of the facies *BD*, *RC*, *YF*, etc., then we should be justified in believing that the characters of the colour and mode of branching are of little or no importance for the species in the struggle for existence, but are due to the direct action of the environment (*e.g.* sunlight, food supply, strength of currents, proximity of neighbouring zoophytes, presence of epizoic crustacea, etc.).

Conversely, we may argue that if the colour and mode of branching are of little importance in the struggle for existence of the species the offspring of a single pair of parents will probably show a great range of variation in these characters, $BD \times BD$ giving rise to *BD*'s, *RC*'s, *YF*'s, etc. in varying proportions.

It is impossible to believe that the struggle for existence has much influence upon the colour of these Alcyonarians. There is no evidence that the colours can be of assistance to the species either as apatetic colours, hiding the individuals from their enemies by resembling the surroundings or some other dangerous zoophyte, or as aposematic colours, signalising some dangerous sting or abhorrent taste.

Spongodes are, so far as my experience goes, extremely conspicuous in their proper surroundings, and do not mimic any other zoophyte that is usually associated with them on the same reef. If they were of the nature of warning colours we should expect to find them on the Müllerian principle of one or two distinct kinds, and arranged in simple patterns instead of the endless shades of tone and tint and kaleidoscopic arrangement that they exhibit. It is difficult to suggest any use that these colours can be to the Alcyonarian, and they should be regarded as being of a purely physical and chemical character, as the green of chlorophyll and the red of haemoglobin, and having no biological significance.

The exact form and mode of branching of the colonies must in my opinion depend very largely upon the external conditions of the individuals. Just as a tree or shrub will vary in form according to its exposure to the wind, the character of the soil, and the proximity of other shrubs and trees, so will a *Spongodes* vary in form according to the strength of the tides flowing over it, the amount of food these tides bring, the proximity to other zoophytes, the exposure to sunlight, and other external conditions. The external conditions that may influence the growth of a *Spongodes* are so many that it is not surprising that we find so many differences in the style of ramification. One specimen may be free to expand in any direction and receive the full benefit of all the sun's rays that penetrate to the depth of water in which it lives, whereas another not a foot away may be impeded in one direction or another by the branches of a great Madrepore and sheltered from the heat and light of the sun by the shadows which the great coral casts. It appears to me therefore far more probable that the critical condition of life for a *Spongodes* is not that it should branch in any one pattern that is inherited from its parents, but that it should be able to adapt itself to any one combination of the great variety of conditions which it may happen to meet in the course of its development. Apart from the purely physical conditions determining the shape of a colony, there is one biological condition which is probably of very great importance. It is well known to those who have handled museum specimens of *Spongodes* and many other Alcyonarians that Crustacea of various kinds are frequently found entangled in the branches; and Mr Gardiner has called my attention in his manuscript notes to these Crustacea and the striking similarity of their colours to the colours of their host. It is very probable that these Crustacea render an important service to the *Spongodes* in keeping their surfaces free from the larvae of Sponges, Barnacles, sedentary worms and other animals, and it is also probable that the character of the ultimate ramifications is due in no small measure to the size and shape of these important epizoites. The manner in which the epizoic crabs affect the growth of *Pocillopora*, *Seriatopora*, and other corals, and form galls, is well known. There is some reason to believe, as stated on p. 495, that the tubes of *Solenocaulon* are caused by the Alpheids which infest

this Briareid in a similar manner. It is unreasonable to suggest that *Spongodes* is not also influenced in its growth by its epizoic crabs. In fact it may be that the differences known to systematists as divaricate, glomerate and foliate growth are due to the crabs, and not to the inherent characters of the species of *Spongodes*.

The colour and mode of branching of these Alcyonarians being unsatisfactory characters for purposes of specific classification, there remain the spicules and the more minute internal anatomy to appeal to. While appreciating very fully the assistance that the examination and measurement of spicules renders in some cases, I am convinced that in many genera the spicules are liable to very great variation, and are very untrustworthy for our purpose. A discussion of this point must however be postponed until my researches have been completed. It is upon the anatomical characters of the anthocodiae and the general canal system connecting the polyps that we must ultimately base our division of the genera into specific groups. This however involves the careful investigation of a large number of well-preserved specimens belonging to each genus from several localities, and can only be accomplished by degrees and in the course of many years. It is not possible, however, for any zoologist who undertakes to write an account of such a collection of Alcyonarians as the one made by Mr Gardiner in the Maldives to undertake this task for all the genera he may find in it. Miss Pratt has shown in Part II. of this paper the manner in which the work may be done in the case of two or three closely-related genera. On the other hand it is to my mind very desirable that a general account of such collections should be published as soon as possible, and to do this a provisional arrangement of the specimens in specific groups should be made.

It appears to me that the proposal recently made by Bernard (3), so far as I can understand it, is open to many objections. The use of a number instead of a name is not only of no advantage, but it is very dull and uninspiring. The prominence that is given to the locality in the case of these shallow water-marine forms is also to my mind undesirable.

This Part contains an account of all the Alcyonacea, with the exception of the genera *Alcyonium*, *Sarcophytum*, *Lobophytum*, and *Sclerophytum*, and of all the Gorgonacea Scleraxonia.

The most abundant species of Alcyonacea belong to the genera *Sarcophytum*, *Lobophytum*, and the new genus *Sclerophytum*. These genera have been carefully studied by Miss E. M. Pratt, and are described in a separate paper. The remainder belong to the genera *Telesto*, *Xenia*, *Spongodes*, *Chironephthya*, *Siphonogorgia*, and *Heliopora*. The Gorgonacea Scleraxonia are represented by the genera *Solenocaulon* and *Melitodes*. The Stolonifera appear to be rare in the Maldives. Not a single specimen of the genus *Clavularia* was obtained. Mr Gardiner informs me that the genus *Tubipora* is very scarce throughout the Maldives; "one of my boys brought me a small piece (decaying) from the edge of the W. reef at Hulule. I saw one colony at Maradu, Addu Atoll, but do not remember to have seen it growing elsewhere." The absence of *Clavularia* from the Maldives is interesting in view of its immense abundance on the coral reefs of many parts of the Malay archipelago, Torres Straits, and elsewhere in the S. Pacific. It does not appear to occur on the coast of Ceylon, of the Malay peninsula, or of Singapore, nor on the other hand in the Red Sea, Zanzibar, or East Coast of Africa.

Tubipora, however, is abundant on the coast of Zanzibar, the Seychelles, and the Red Sea, very rare in the Maldives, and I have Professor Herdman's authority for saying that it must be scarce or rare off the coast of Ceylon, as not a single specimen occurs in his extensive collection from those waters. It is difficult to account for the scarcity of *Tubipora* in these regions, as on most of the coral reefs of the world it is one of the most abundant and luxuriant Alcyonarians. The absence of the characteristic Zanzibar genera *Coelogorgia* and *Lemnalia* from the Maldives is also a noteworthy feature.

On the other hand the genus *Heliopora*, which is so widely distributed on the reefs of the Malay archipelago, Torres Straits, and Pacific Ocean, is also abundant in the Maldives. Mr Gardiner writes that at Hulule Male "*Heliopora* occurs practically everywhere near the reef inside the boulder zone if other corals grow. It does not, however, live near the *velu* (lagoonlet, Hulule being a *faro* or small atoll). It is not at all common to the west, but great masses are found to the east, usually dead in the centre with plates growing out all round, the tops just awash at low-tide springs. Some of the masses are five to six feet across, but none have any great thickness. All now lie freely (not attached) on the sand. The polyps are but rarely expanded in the daytime, and then only towards the bases of the branches, that is, in the shade. The corallum does not appear to be bored by any other organism."

Speaking more generally he writes, "*Heliopora* is nowhere of any special importance in building the reefs. It may be found almost anywhere towards the outer sides of the atolls on the reefs. *Small* colonies may grow on the reef flat, but they are very rare."

The genus *Xenia* does not appear to be very abundant, nor to reach a large size. The specimens sent to me were found at Addu in the extreme S. of the archipelago and at N. Male in the northern half, and this suggests that the genus probably occurs sporadically throughout the archipelago. The Maldives, however, do not seem to be as favourable for the growth of this form as the Chagos archipelago in the S., Zanzibar and the Red Sea to the west, or such localities as New Britain, Torres Straits, and the coast of Celebes and Ternate.

Spongodes appears to be extremely abundant and varied in character. When all the specimens are placed side by side, however, there is no one feature to be observed to distinguish them from the *Spongodes* of other reefs. The genus appears to be widely spread over the whole of the Red Sea, Indian Ocean, Malayan seas, and the tropical Pacific Ocean. It is remarkable that the genera *Nephthya* and *Paraspongodes* are so rare, being represented by only one specimen of each.

The genus *Chironephthya* (W. and S.), which was for many years after its discovery by the Challenger expedition known to occur at a depth of 200 fathoms in Japanese waters, has recently been described by Hiles (12) from New Britain in shallow water, probably occurs in shallow water at Funafuti (cf. Whitelegge 24, *Siphonogorgia macrospina*), occurs off Singapore (e. coll. Bedford), off Ceylon (e. coll. Herdman), and is now shown to be abundant in depths of about 20 fathoms in the Maldive archipelago. The genera *Solenocaulon* and *Siphonogorgia* appear to have a distribution very similar to that of *Spongodes*.

Family **Xeniidae.**

Genus *Xenia.* Savigny.

In writing upon this genus I must explain that I do not include in it those species which belong to the genus *Heteroxenia* of Kölliker. This explanation is necessary in view of the recently published paper by Kükenthal (16) in which the proposal is again brought forward to merge *Heteroxenia* into *Xenia.*

The genus *Heteroxenia* was established by Kölliker for a species found at Port Denison in Australia which exhibited dimorphism, and was named *Heteroxenia Elisabethae.* Klunzinger (14) in 1879, upon the examination of some specimens of *Xenia fuscescens* which he found in the Red Sea, threw some doubt on the validity of the genus *Heteroxenia.*

Up to this point no detailed account had been given of the structure of the small polyps which Kölliker regarded as siphonozooids, and it was a question whether they were really siphonozooids or young polyps not yet developed into their adult form.

In 1895 G. C. Bourne (4) examined and described the siphonozooids of a specimen of a species which he attributed to *Heteroxenia Elisabethae* (Köll.) from Zanzibar, and Ashworth (1) subsequently examined the same specimen and confirmed Bourne's determination of the species.

Both Bourne and Ashworth made careful anatomical examinations of the specimen, studying in minute detail and with the best histological methods the structure of the siphonozooids, and they came to the conclusion that there are true siphonozooids in this species, and that they can be distinguished without difficulty from young autozooids. It does not appear from Kükenthal's recent paper that he has made any anatomical investigation of a species of *Heteroxenia,* and the arguments used in defence of his proposal show no advance on those of Klunzinger which were considered and rejected by Bourne and Ashworth.

Whether the specimens collected by Klunzinger in the Red Sea, and named by him *Xenia fuscescens* Ehr., are or are not identical with *Heteroxenia Elisabethae* is a point upon which I will not venture to express an opinion, but I cannot refrain from saying that it is premature at present to assert that they are. I cannot therefore accept Kükenthal's view that the genus *Heteroxenia* should be suppressed. It is unfortunate that no specimens of a dimorphic Xeniid are to be found in Mr Gardiner's collection, and that only eight specimens of one species of *Xenia* were discovered in the Maldives. At present therefore it appears that the genus *Heteroxenia* is confined to the exceptionally hot waters of N. Australia, the Red Sea, and Zanzibar, together with one species *Heteroxenia capensis* with distinct characters from cooler water off S. Africa.

No specimens have yet been observed in the extensive collections of Alcyonaria that I have examined from the Maldives, Ceylon, Singapore, and the Malay archipelago. If, by any chance, the single specimen of *Heteroxenia Elisabethae* in the Museum Godeffroy, which Kölliker examined, was wrongly labelled, and did not originally come from Port Denison in Australia, the geographical distribution of the genus might not seem so extraordinary as it is. It is true there is no definite reason for doubting the locality of Kölliker's specimen, but it is noteworthy that notwithstanding the careful investigations of Saville

Kent, Haddon and others in Torres Straits and elsewhere the occurrence of this genus in tropical Australian waters has not been confirmed.

In conclusion I may say that although I cannot accept Kükenthal's proposal to merge *Heteroxenia* into the genus *Xenia*, I think it is just possible that this is the course which will ultimately have to be adopted. If it can be shown that notwithstanding the difference in character of the young autozooids and the siphonozooids the latter do develop later the character of the adult autozooids, then the genus must go. This can only be proved by the examination and comparison of a large number of specimens from the same locality. Until this is done it is not only very inconvenient to the systematist but contrary to the best principles of scientific investigation to suppress the genus.

Xenia garciae Bourne.

Two specimens, one from the reef at Maradu, Addu Atoll, and one from Hulule, Male A., were obtained by Mr Gardiner.

The former consists of about fourteen clumps, perfectly white in colour, attached to what appears to be a piece of shell 60 mm. × 30 mm. in size. Some of the clumps are free, and represent single colonies, others are constricted or lobed, and may represent two or more colonies fused together. Each clump or colony is very flat, rising in the centre only 2 or 3 millimetres from the shell.

The second specimen (from Male A.) consists of 10 clumps, pale bluish-green in colour, attached to a rounded knob of dead madrepore, coated with nullipore coral. Some of the clumps are free, others are attached at the base in pairs or triplets, and I think it is probable that each pair or triplet represents one branched colony. An interesting point of difference between the specimens is that in the last-named each clump rises 4 or 5 mm. from the base of attachment, showing a pronounced stalk (sterile portion).

A careful examination of the polyps shows that both specimens clearly belong to Bourne's species from *Diego Garcia*, and the differences in colour and height may be accounted for by differences of age or position on the reef.

It is not necessary to publish the measurements of the polyps I made. They agree very closely with those given for the species in Dr Ashworth's table (2). I may say, however, that I have compared the polyps with one taken from Mr Bourne's type specimen, which was kindly lent to me for the purpose, and there can be no doubt of the identity of the species.

From N. Male, 30 fathoms N. of the atoll, Mr Gardiner obtained six very small specimens of a species of *Xenia* closely related to *Xenia garciae*. They are too young to place definitely in any of the hitherto described species.

Family **Telestidae** (Milne Edwards).

Genus *Telesto* (Lamaroux).

Two distinct species of this genus were found in the collection from the Maldives. One of them is probably *Telesto trichostemma* (Dana), and the other is new. The new form I propose to call *Telesto rubra*. The specimens of *Telesto trichostemma* were dredged in 25 fathoms in Mulaku Atoll and in 24 fathoms Miladumadulu Atoll.

One fragment of the new species was found in the same dredging in Mulaku, and the other in Mahlos Atoll, 23 fathoms. It is to be noticed that both specimens of the new species are freely encrusted with a sponge, a *Prosuberites*, in the case of the Mahlos specimen, and a *Leptosia* sp. n. in the case of the Mulaku specimen. The *Telesto trichostemma*, however, is entirely free from sponge encrustations.

The occurrence of encrusting sponges on *Telesto* has been recorded by Dana (5) in the case of *Telesto fruticulosa*, by Wright and Studer (23) in *Telesto trichostemma* from Torres Straits, and by Miss Hiles (12) in *T. rupicola* from Blanche Bay.

In a former paper (10) I suggested that *Telesto* should be removed from the family Clavulariidae and placed among the Alcyonidae. At the time I wrote that paper I had very little acquaintance with the genus, and I am now in agreement with May (17), who suggests the retention of Milne Edwards' family Telestidae in a position intermediate between the Clavulariidae and the Alcyonidae.

Telesto rubra sp. nov.

Specimen A. Mulaku Atoll, 25 fathoms. Fine mud and rubble at the edge of the lagoon.

Specimen B. Mahlos Atoll, 23 fathoms, N.E. lagoon.

Both of these specimens are unfortunately fragmentary, and as the base is missing I have no knowledge of the method by which the colony is fixed to the bottom. The species is easily recognised, however, by the bright pink to red colour of the tubes. The spicules of the body-walls of the axial and lateral polyps become firmly fused together to form a solid tubular skeleton, perforated by numerous irregular and minute channels, traversed by strands of mesogloea. These tubes have a remarkable similarity in their construction to the tubes of the genus *Tubipora*, but are distinguished by the presence of eight distinct longitudinal ridges (Fig. 2).

In *Telesto trichostemma* Studer states that "the spicules surrounding the elongated digestive cavities of the primary and secondary axial polyps lie in such intimate contact with one another that, in the older parts of the colony, they form a continuous calcareous cylinder. Towards the base this is further strengthened by the horny substance secreted between the spicules." These tubes show as in *T. rubra* eight longitudinal ridges. In *T. trichostemma*, and in other species of *Telesto* which form a tubular skeleton that remains rigid on drying or slight treatment with caustic potash, the spicules appear to be bound together by a horny substance developed in the mesogloea. In the new species this is not the case, no appreciable amount of horny substance being noticed either in the sections of decalcified or in dried specimens. The rigidity of the skeleton is entirely due to the

calcium carbonate, and prolonged boiling in caustic potash does not soften the tubes or permit of the isolation of the spicules.

The anthocodiae are completely retractile, and when that part of the body-wall of a polyp is examined which is situated at the junction of the anthocodia with the non-retractile portion, a few isolated spindle-shaped spicules can be seen. These spicules are very different in form to those of any species of *Telesto* that has hitherto been described, and it is perfectly certain that they grow very rapidly in size until they become as firmly fixed or fused together as are the spicules in the tubes of *Tubipora* (Figs. 5 and 6).

In *Telesto trichostemma* it will be noticed that according to Studer (23) it is only in the "older parts of the colony" that continuous calcareous cylinders are formed. In *T. rubra*, on the contrary, the spicules at the base of the verrucae of the youngest buds are fused to form a continuous calcareous skeleton. The secondary branches and the young polyps are given off from the axial polyps at an angle which is almost a right angle. This is another feature in which the new species seems to be peculiar.

The tentacles of the retracted polyps are, in spirit, snow white or pale yellow. They exhibit a row of about eight pinnae on each side, and each pinna is supported by a curved spindle-shaped spicule 0·14 mm. in length. There is also a series of rod to spindle-shaped slightly tuberculated spicules on the aboral side of the rachis of each tentacle (Figs. 3 and 4).

In the specimen of *T. trichostemma* in the same collection the tentacles are quite free from spicules.

The general surface of ectoderm of nearly all parts of the colony is destroyed by the encrusting sponge.

I am greatly indebted to Professor Topsent of Rennes for examining these sponges, and very kindly sending me a report upon them.

The sponge that occurs on the Mahlos atoll specimen is *Prosuberites epiphytum* (Lamarck). Professor Topsent tells me further that the blue-green colour is due to the Beggiatoaceae which frequently invade *Terpis fugax*, and were named by Carter *Hypheothrix coerulea*.

The sponge that occurs on the Mulaku specimen appears to be a new species of the genus *Leptosia*.

The characters of the new species may be diagnosed as follows:—Colony consisting of single upright axial polyps bearing a few secondary branches of the same nature. Several young polyps are borne by the main stem and secondary branches. All the polyps are completely retractile, the young polyps forming verrucae about 2 mm. in height. The axial polyps, branches, and verrucae 1·75 mm. in diameter in the Maldive specimens. Body-wall of the axial polyps and verrucae supported by a firm, perforated, tubular, calcareous skeleton, which is pink in colour. Very few free spindle-shaped spicules at the growing edges of the tubes. External surface of the tubes marked by eight longitudinal ridges. Tentacles of the polyps white or pale yellow, with eight or nine pinnae on each side supported by white curved spindles (·14 × ·015) and other spicules. Locality, Maldive Islands, 23—25 fathoms.

Telesto trichostemma Dana (5); Wright and Studer (22 and 23).

From Mulaku Atoll, 25 fathoms, fine mud and rubble, and Miladumadulu Atoll, 24 fathoms, from one of the eastern passages.

One of the specimens which, with some hesitation, I place in this species consists of three stems, one of which is connected with a characteristic flattened, anastomosing stolon growing on a sponge. The longest stem is 115 mm. in length, and a little over 1 mm. in diameter. The stems consist of a single axial polyp, bearing numerous lateral polyps, situated at an acute angle to it. As in *T. trichostemma* from Torres Straits, the spicules of the older parts of the colony join to form a solid cylinder marked externally by eight longitudinal ridges, but after boiling in caustic potash for some time the spicules can be separated into groups or clusters, and I cannot find that they are supported by a definite horny substance.

The spicules are very irregular in shape, but correspond in general form with those figured by Studer, they are however decidedly larger than those of the Challenger specimens, for whereas Studer gives 0·2 mm. as the greatest length, there are very few of the larger spicules in my preparation less than 0·24 mm. in length.

Studer states that the Challenger specimens were covered with an encrusting sponge. It is therefore remarkable that the Maldive specimen is not, considering the fact that both specimens of *Telesto rubra* from the same locality are so covered.

The Challenger specimen of this species was obtained in shallow water in Torres Straits, and it may be questioned whether it is really identical with the species figured and very imperfectly described by Dana from the Fiji Islands.

In the Maldive specimens most of the polyps are fully expanded, but the remainder show that the anthocodiae can be retracted as completely as in *Telesto rubra*. The tentacles are quite devoid of spicules, and are of a reddish-brown colour. They bear about 12 pinnae on each side.

The second specimen from Miladumadulu Atoll is only a fragment. It is much whiter than the Mulaku specimen, and the polyps are all retracted. Unfortunately the bottle containing this specimen was broken in transit, and it was quite dry on arrival.

The distinctions between the species of the genus *Telesto* have not at present been very clearly defined, and further anatomical investigation is desirable before any such definition is attempted.

I have examined specimens which have been attributed to the species *Telesto rupicola* from Bahia and from Jamaica in the collection of the British Museum, and have been much impressed with the general similarity in habit to these specimens from the Maldives. In the minute skeletal characters, however, the Maldive specimens resemble more closely the description given of *T. trichostemma* from Torres Straits by Studer, and they differ, moreover, from *T. rupicola* in their opaque reddish-brown tentacles.

I have also examined a specimen of *Telesto* from the Persian Gulf, having close affinities with von Koch's *Telesto prolifera* from the Gulf of Siam, and a specimen labelled *T. aurantiaca* from Kurrachee in the collection of the British Museum.

I am inclined to believe that all these species ought to be merged into one, a very variable and widely distributed species, which should be called *T. rupicola* (Müller). Until, however, further anatomical investigation has been made I think it is desirable to keep the American form distinct as *T. rupicola*, and to call the others *T. trichostemma* (Dana). There are not enough specimens in Mr Gardiner's collection to determine the extent to

which the species varies in form in one group of islands. The species *T. aurantiaca* ought to disappear from the literature as Lamaroux' description of it is far too incomplete to be any guide to its determination.

Family **Nephthyidae** Verrill.

This family has recently been rearranged by Kükenthal (15), who recognises now only four genera; *Ammothea*, *Paraspongodes*, *Nephthya*, and *Spongodes*. Unfortunately we are still in almost complete ignorance of the anatomy of any of the species, and there are many reasons for regarding Kükenthal's new system as not entirely satisfactory. In the revised genera *Nephthya* and *Spongodes* the anthocodiae are supported on the outer side by one or more than one specially long spicule, the supporting bundle (Stützbündel). These are not present in the other two genera. The genera *Ammothea* and *Nephthya* have the anthocodiae arranged in "catkins," in the other two genera the anthocodiae are in bundles or isolated.

As regards the "Stützbündel" there may be observed in many colonies considerable variations in different regions, some anthocodiae possessing a very well-marked Stützbündel, and others having no sign of one. On the other hand the very pronounced "catkin" arrangement which is seen in many specimens shades off into bundles with closely-set anthocodiae in a manner which often makes the determination of the genus a difficult one. For example, I had some difficulty in determining whether the arrangement of the anthocodiae in the specimen which I have referred to *Nephthya inermis* is or is not a "catkin" within the meaning of the definition. For the present, however, it is best to work upon Kükenthal's system, which possesses the great advantage of reducing very materially the number of ill-defined genera which appear in our literature.

Of the genus *Spongodes* about 70 species have been described from the Red Sea, East Coast of Africa, Malay Archipelago, China, Japan, Australia, New Guinea, New Britain (see 15, 17, 19). It is a remarkable fact that only one species, *Spongodes* (*Morchellana*) *spinulosa*, has been described from the Indian Ocean (9), and only one species of *Nephthya* (*N. burmaensis* Ridley). The genus is very abundant in the Maldives, as the following notes show. I have a specimen from the Persian Gulf. I have several specimens from Singapore. It occurs on the coast of Ceylon, and probably is abundant all over the Indian Ocean.

Time has not permitted me to make a detailed examination of all the specimens, and I feel that the task of attempting to identify them with any of the seventy defined species or to describe any of them as new to science would yield results out of all proportion to the labour involved. The presence of so many specimens of different forms of growth, of colour, of spiculation living under very similar conditions in one group of islands suggests very forcibly that all these specimens represent but different facies of one variable species. Anatomical investigation of a thoroughly searching character can alone determine this point, and until it is made the task of species-making should in my opinion be suspended. A very large number of the new species that have been described are founded upon one small specimen.

We have no information to guide us as to the changes that take place during the growth of a colony from a height of 20 mm. to a height of 200 mm., nor the influence that variations in depth, in the strength of tides, or the nature of the sea-bottom, the associated crab, mollusks, and other creatures have upon the colour, form, and size of the colonies.

We must remember that nearly all the specimens that are brought to Europe from the tropical seas preserved in spirit are small specimens. They are probably also young specimens of large species. Full-grown specimens may reach a size of 300 to 400 mm. or more in diameter, but these are not easy to detach from their base of attachment, and it is, as a rule, impossible to preserve them satisfactorily and send them home.

The study of the *Spongodes* collection from the Maldives throws, however, a little light on one or two points of general interest.

In the first place we find in this one archipelago a very wide range of variation. The colour of the spicules varies from pure white (as in the specimen from Kolumadulu) through many shades of yellow, orange, brown, pink, red, purple, chocolate to black (as in the stalk of the specimens from Fadifolu).

In some forms the spicules are enormously large, in others they are relatively small.

A few forms with very divaricate branches are found, but others have a remarkably compact habit of growth.

These differences are not more pronounced between specimens found in the extreme north of the archipelago and those in the extreme south. On the contrary, the specimens from the same atoll are sometimes most diverse in colour. For example, the large coarse golden-yellow specimens from N. Male, 20 fathoms S.W. of the atoll, are in marked contrast to the delicate chocolate-coloured specimens from 24 fathoms in the shoal at the centre of the atoll, and the pale yellow form, like *Spongodes flabellifera* found in the S. atoll in 25 fathoms. Three small specimens from Hulule Male, 25 to 30 fathoms, are so much alike in colour, spiculation and size of anthocodiae that they clearly belong to the same species, and yet they are of such different form of growth that they might be delegated to different divisions of the genus. The specimen from Miladumadulu in the north of the archipelago is very closely related to the single specimen from Addu in the extreme S. They are much more closely related than are the two dusky-brown specimens and the two red divaricate specimens which were obtained in the same dredging in the Fadifolu atoll. There is nothing to show that geographically there are any limits to the distribution of the species within the archipelago. There are probably no characteristic features distinguishing the *Spongodes* of one atoll from that of another. But we can go further than this and say that there are no characteristic features which appear to distinguish the *Spongodes* of the Maldives from those of suitable localities in the other regions of the Indian and Pacific Oceans. There are specimens from the Maldive archipelago that clearly belong to the same species as specimens in my collections from Singapore, New Britain, and Fiji. There can be no doubt that specimens are present in the Maldives, which under our present system would be referred to Holm's species (13) *Spongodes spinifera*, founded on a specimen obtained in the Fiji Islands, to Kükenthal's species (15) *Spongodes splendens*, founded on a specimen obtained in Ternate, to Studer's species (22) *S. flabellifera*, obtained in Japan.

All these facts appear to me to point to the conclusion that the species of the genus *Spongodes* are extremely variable, and have a very wide geographical range in tropical waters. Whether there is only one true species is a question to which with our present want of exact anatomical knowledge no answer can be given. I am convinced, however, that the characters upon which new species have been founded in recent years in such large numbers are untrustworthy for the purposes.

Two lines of inquiry might yield interesting results. Firstly, there should be a careful

anatomical comparison of the structure of the stomodaeum, mesenterial filaments, and canal systems of two or three distinct facies, and secondly, a numerical statement of the range of variation in the length of the spicules of the Stützbündel, the number of anthocodiae on the secondary branches and other measurable characters in the different parts of one large colony.

The following is a list of the specimens sent to me of the genus *Spongodes*.

From Miladumadulu, 24 fathoms; in an E. passage. A small specimen about 30 mm. in height, having the general form of *S. splendens* (Kükenthal). Stalk and branches white, anthocodiae pink.

Another small specimen from the same atoll 20 fathoms, off the reef. This is a little larger than the first specimen. The colour of the anthocodiae is darker, and extends on to the secondary branches, where it shades off into orange.

From Mahlos Atoll, 23 fathoms. A small specimen, about 30 mm. in height, with divaricate branches, having a close resemblance to the description given of *Spongodes rubra* (May) from the Philippines. The stalk and branches are red. The spicules of the tentacles white.

From the same atoll 22 fathoms, passage to N. of Fainu, two small specimens, one white with purplish red supporting spicules, the other yellow with orange terminal branches.

From Fadifolu, 25 fathoms. Middle of N. part of atoll. Two beautiful but small specimens of a form similar to that described as *Spongodes flabellifera* (W. and S.). They are of a delicate shade of pale yellow, with white anthocodiae.

From the same atoll 14—20 fathoms there are four specimens. Two are of a dusky-brown colour, and are of the same facies as the two specimens mentioned. The other two are more divaricate, with larger anthocodiae, and the colouring is very remarkable. The stalk is black to very dark brown, the branches red, and the anthocodiae white. The form of growth is very similar to that of *S. rubra* (May).

From the same atoll and dredging a very fine specimen 100 mm. in height with a stalk 30 mm. is preserved, coming nearest to Kükenthal's species *S. splendens*. The stalk is yellow, branches yellowish-red, terminal branches red, and the crown of tentacles white.

From N. Male one specimen from 20 fathoms S.W. of atoll, and two specimens labelled Hulule, Male A., answer to the description of *Spongodes spinifera* Holm.

There can be little doubt that these specimens are closely related to the specimen upon which Holm (13) founded his species, although they appear to be older and more fully developed examples of it. The characteristic features of the species are (1) the enormous spicules of the walls of the branches, (2) the very long projecting chief spicule of the Stützbündel, and the dark gold or yellow ochre colour.

I may here call attention to two serious misprints in the literature of the species. In Holm's paper (p. 39) the length of the spicules of the wall of the branches is given as 0·7 mm. It is quite clear that the statement on p. 40 that these spicules may attain a length of 7 mm., however, is the correct one.

In Kükenthal's table (15) of the species of *Spongodes* the length of these spicules is given as 4 mm., an obvious misprint for 7 mm.

The specimen from 20 fathoms is 100 mm. in height, with a stalk 35 mm. in length by 30 in diameter. The spicules of the wall of the branched portion of the colony are very

large, and irregularly scattered. Many of them reach to the extreme length of 7 mm., and frequently exhibit one bifurcated extremity. The colour of the colony is dark golden.

The two specimens from Hulule, Male, are rather smaller. The spicules of the walls of the branched portion are not quite so large as in the N. Male specimens, not exceeding 6 mm. in length, and I have noticed only a very few with a bifurcated extremity. The spicules, however, in this part of the colony and in the polyps are rather stouter in build than in the 20 fathom specimen, the largest spicules of the former specimens being about $5{\cdot}5 \times 0{\cdot}7$ mm. and of the latter $7 \times 0{\cdot}7$ mm.

From N. Male, 24 fathoms. Three specimens of a dark-chocolate colour, having the general form of *S. splendens* (Kükenthal), were obtained near the shoal at the centre of the atoll.

From N. Male, 25 fathoms. One specimen yellow in colour, having the form of *S. flabellifera*, was found in the middle of the S. atoll.

From N. Male, 27 fathoms. A fragment, from a form similar to the last-named facies.

From Hulule, Male Atoll, 25 to 30 fathoms. Four small specimens. One uniformly pale yellow. Three with yellow stalks and branches, red supporting spicules, white tentacles. The form of growth is variable in the three last-named specimens. They would be regarded perhaps as young specimens of *Spongodes splendens*.

From S. Nilandu, 25 fathoms, W. Passage. This is a small specimen 30 mm. in height, of very compact form of growth, similar in some respects to *S. glomerata* (May). Associated with it were a red chiton and a pelecypod.

From Kolumadulu, 35 fathoms. This specimen, about 40 mm. in height, is perhaps the most beautiful of the series. The stalk is white, the branches and anthocodiae also white, but the main stem contains a few large scattered pale purple spicules. It has a close resemblance in many respects to Holm's species *Spongodes pallida*, but the lowermost expanded branches are most delicately fringed so as to have an appearance like fine lace.

From Haddumati, 40 fathoms. A small specimen of a pale brown colour related to the last named.

Two specimens from Suvadiva Atoll, 25 fathoms. Across the mouth of a passage. The specimens are about 80 mm. in height, with a maximum expanse across the arms of 80 mm. The base is missing in both specimens. From a thick main stem several branches arise, which may again divide into several branches of the second order, which bear the clusters of anthocodiae. There are 15—20 anthocodiae in each cluster. The colour is uniformly rose-pink in the main stem and branches, but somewhat dark in the terminal twigs and anthocodial clusters. The colour appears to be entirely due to the spicules, which are long, delicate spindles, irregularly scattered on the surface branches. These spicules vary considerably in size. They are on an average 5 mm. in length, but many are 7 mm., and a few that I have measured were 9 mm. in length. These are, I believe, the longest spicules known in the group of the Alcyonaria. In the anthocodiae one or two spicules 3 mm. in length, predominate, projecting one or two millimetres beyond the tentacles. The rest of the spicules of the anthocodiae are small and slightly curved. They appear to be smaller (0·75—0·5 in length) than in the type-specimen (1·0 mm.). They are also thicker.

The specimens agree better with the description of W. and S.'s species *S. macrospina* than with that of any other, but in the extraordinary length of the spicules of the branches and in the smaller of the secondary spicules of the anthocodiae they present differences which in the opinion of some authors might be regarded as of specific value.

From the same atoll, 31 fathoms. A specimen about 45 mm. in height, having the general form of *S. splendens* (Kükenthal), with pale yellow stalk, yellow branches, and purplish-red supporting spicules.

From the same atoll, 39 fathoms. A small very divaricate form with white stalk and stem, but the terminal branches and supporting spicules bright orange in colour.

From Addu Atoll, 25 fathoms. Near a passage. A small red specimen of very compact habit, like the specimen from S. Nilandu.

In addition to the numerous specimens of the genus *Spongodes* in the collection there are two specimens which must be referred to the same family, but as one of them is probably a young colony and the other only a fragment of a colony I have not very carefully studied them.

Nephthya inermis Holm. (?)

Kolumadulu Atoll, 22 fathoms, near W. Passage. This specimen is of a dull brown colour. It is 50 mm. in height, with a stalk 25 mm. in length. It appears to be closely related to Holm's specimens from the Hirudo Straits, Japan, 36 fathoms. Holm's largest specimen was 550 mm. in height.

Paraspongodes pustulosa (W. and S.) (?)

Mahlos Atoll, 23 fathoms. Inner part of passage to S.E. This specimen is apparently only a portion of a branch. It is 50 mm. in length, with numerous irregular purplish-red spicules in the superficial parts of the coenenchym and yellow spicules in the crown and tentacles. Wright and Studer's specimen (described under the genus *Scleronephthya*) came from a depth of 18 fathoms off the Philippine Islands.

Family **Siphonogorginae.**

Genus *Chironephthya* (Figs. 8, 9, 10).

The genus *Chironephthya* was constituted by Wright and Studer (22) for three species obtained by the Challenger expedition on the *Hyalonema* ground, Japan, in 345 fathoms. The genus has somewhat the form of a *Nephthya*, but undoubtedly approaches most closely to the genus *Siphonogorgia* (Köll.). According to the authors, however, it differs in that it "is essentially distinguished from *Siphonogorgia* by the fact that the polyps occur along the entire course of the branches, and are less retractile." As regards the first of these, the distinction breaks down in the fact that in the species *Siphonogorgia pustulosa*, described by the same authors in the supplement to the Alcyonaria and in Kükenthal's species *S. miniacea* and *S. cylindrica* (15) the polyps, *i.e.* the anthocodiae, occur all along the branches as in *Chironephthya*. As regards the retractility of the polyps, a point upon which less stress can be laid, as I have previously pointed out, it must be noted that the polyps of *Siphonogorgia pustulosa* (W. and S.) do not appear to be much more retractile than those of *Chironephthya*. The increase of knowledge of these two genera shows that they are very closely related, and should perhaps be merged into one. The three species hitherto known do not appear to me to differ very materially from one another, and it is highly probable that when more specimens are obtained from the same ground intermediate varieties will be found. In 1900 Miss Hiles (12) described two fragments of a *Chironephthya* with characters

most closely approximating to the description of *C. scoparia.* This specimen was obtained by Dr Willey in shallow water off the coast of New Britain. I have recently discovered in a collection made by Mr Bedford at Singapore a specimen of *Chironephthya* from 10 fathoms of water, which I hope to describe in a future memoir. In Mr Gardiner's collection from the Maldives there are several specimens obtained in water of about 20 fathoms in depth which present several features of particular interest.

Since the publication of the Challenger reports, then, we have learned firstly that the genus is not confined to deep water, and secondly that it has a wide geographical distribution in the eastern seas. It must also be noted here in anticipation of the special description which follows that notwithstanding certain features in which the species or "facies" resemble one another, there is such a well-marked variability in other important structures that it is extremely difficult to determine even provisionally the range of specific characters. It really becomes a question whether it is more convenient to consider all the specimens hitherto obtained to belong to one widely distributed but very variable species, or to describe almost every specimen that is obtained as a new species. Our knowledge is not yet sufficiently advanced to adopt the former course, and the latter appears to me to be contrary to the general trend of increasing knowledge and quite unscientific.

Chironephthya variabilis. New species.

The specimens collected by Mr Gardiner may be arranged as follows:

From Mahlos Atoll 20 fathoms, N.E. Lagoon. Two complete specimens (*A*, *B*) and several fragments (*C*).

From Mahlos Atoll, 22 fathoms, N. Fainu. One complete specimen (*D*) and fragment (*E*).

From Mahlos Atoll, 23 fathoms. Several fragments (*F*).

From S. Nilandu, 24 fathoms. One complete specimen (*G*) and some fragments (*H*).

There are also smaller fragments from dredgings in nearly all the atolls.

The sizes of the complete specimens were

A, 45 mm. in height.

B, 34 mm. in height.

D, 50 mm. in height.

G, 65 mm. in height.

The most striking feature in connection with these specimens is the extraordinary variability in colour. The colour of the spicules of the anthocodiae is usually in marked contrast to that of the general coenenchym. The spicules of the anthocodiae are arranged in a well-developed circlet round the base of the tentacles, which I shall for brevity call the "crown," and in a triangle guarding the lower part of the aboral surface of the tentacles. These triangles I shall call for the same reason the "points" (Figs. 9 and 10).

The range of colours is as follows:

A. General coenenchym speckled red and yellow at the base, yellow in the upper part of the stem and branches, very pale yellow crown and points.

B. G. C. dark red at the base fading into pink in the upper part of the stem and branches; crown and points dark purple.

C. G. C. yellow, shading into pink at the termination of the branches, crown and points purple.

D. G. C. red, with a few yellow spicules occurring irregularly among the red ones; crown and points yellow fading into white, the spicules of the crown being more frequently yellow than those of the points.

E. G. C. yellow; crown and points purple.

F. G. C. pink; crown and points purple. (Some fragments have G. C. yellow.)

G. G. C. of the stem red, fading into yellow in the main branches; crown and points orange.

The specimen *D* (Fig. 8) having a total height of 50 mm. has a stalk (barren stem) 23 mm. in length, it is slightly expanded at the base, where it is 8 mm. in diameter and 6·75 mm. at the level of the lowest branch. It bears ten small branches, given off irregularly from all sides of the stem, and some of the larger of these bear rudimentary branchlets. The anthocodiae are crowded at the termination of the branches, but occur more scattered on all parts of the branches and main stem above the stalk. Specimen *G*, having a total height of 65 mm., has a stalk 36 mm. in length. The expanded base of attachment is 11·25 mm. wide, and the stalk narrows to a diameter of 3·5 mm. at the level of the lowest branch. There are only six short branches, the longest being 10 mm. in extreme length.

Further description of these complete specimens is unnecessary, as it is perfectly obvious that they are young colonies which would have altered very materially in form and probably in colour also had they grown to the full size.

The fragments (*H*) from the same locality are in all probability branches of a larger colony which may have reached its maximum size. On these we find a cluster of four or five anthocodiae at the extremity, and others scattered at intervals of 3—5 mm.

It is impossible to say from the evidence of this collection to what size the colonies may grow. I have seen a specimen obtained by Professor Herdman off Ceylon which is over 1 foot in diameter.

In none of the specimens can it be said that there is a very clearly defined spiral arrangement of the anthocodiae, although on some branches an ill-defined spiral arrangement can be observed. I do not consider that the spiral arrangement of the anthocodiae can be used as a character of any specific importance, as it is clearly subject to considerable variation.

In order to discover if possible some character which would be useful as a guide to specific identification I made a careful examination of the anthocodiae of several specimens and branches, carefully comparing the arrangement of the spicules of the crown and points of neighbouring tentacles and polyps. The result was rather disappointing, as a considerable variation was observed throughout. The arrangements of the spicules of the point are not alike even in tentacles of the same polyp, and the range of variation in anthocodiae of the same branch is surprising. However, the investigation has yielded certain general results which may be stated as follows. In the crowns of *Chironephthya variabilis* (Figs. 9, 10) there are usually about ten rows of spicules arranged parallel with one another, and at right angles to the long axis of the anthocodiae. In the points there are four large and prominent spicules arranged *en chevron*, of these the two outer ones are usually larger than the inner. The outer and larger spicules are frequently bent slightly in the middle. The two outer spicules of the chevron are the largest spicules of the anthocodiae. In the angle of the chevron other spicules intrude, the number of which varies with the age of the anthocodiae.

The size and shape of the spicules vary considerably. In young anthocodiae, as for example on *D* (Fig. 9), the largest spicules of the points were 0·5 mm. × 0·04 mm., and the spicules of the crown 0·5 mm. × 0·015 mm. In older anthocodiae, as for example on *F*, they were respectively 0·6 × ·08 and 0·5 × 0·4, and in *E* 0·7 × 0·085 and 0·5 × 0·05 (Fig. 10).

The spicules of the points in *E* might be described as tightly packed, a large number being wedged into the basal part of the triangle, and in the crown the greater stoutness of each spicule causes them to lie much closer together than in the crown of *D*. This tight packing of the spicules of the older specimens renders the anthocodiae much less retractile than in the younger specimens. There is another series which is less regular. The spicules of the anthocodiae of the youngest specimens are usually white, or pale yellow, those of the oldest purple. It is usually in the purple specimens that we find the tightest packing of the spicules. Thus in *D* the spicules are white, in *F* orange, and in *E* purple. It seems a reasonable proposition to suggest that the colouring matter of these spicules changes from white to purple as the colony approaches the light, or as they increase in age, and that the noticeable variations in the series are due to local differences in surroundings.

Before comparing *Chironephthya variabilis* with the species *C. dipsacea*, *C. scoparia*, and *C. crassa* of Wright and Studer (22), it may be pointed out that these authors do not state definitely that the measurements given below refer to the largest spicules of the polyps, but it is probable that this was their intention.

	C. variabilis (mihi)			*C. dipsacea*	*C. scoparia*	*C. crassa*
	D	*E*	*F*			
Crown Spicules	0·5 × ·015	0·5 × 0·05	0·5 × 0·04	0·2 × 0·03	0·7 × 0·04	0·67 × 0·05
Point Spicules	0·5 × 0·04	0·7 × 0·85	0·6 × 0·08	0·12 × 0·017	0·54 × 0·03	0·9 × 0·13

If Wright and Studer's measurements refer either to the greatest size or to the average size of the spicules in these situations it is clear that the range is much greater between *C. dipsacea* and *C. crassa* than it is between any two examples that I have studied in this collection. As regards the arrangement of the spicules Wright and Studer state that in *C. dipsacea* and *C. scoparia* the spicules of the points are arranged in a Λ-shaped manner, but no detailed description or figure has been given.

I may say, however, that from a careful examination of the type specimens in the British Museum I am convinced that the arrangement of the spicules of the points in all three of the Challenger species is essentially the same as it is in *C. variabilis* mihi. There are variations in size and in crowding as in the Maldive specimens, but the four principal spicules of the points can be recognised in most of the anthocodiae I examined. Turning now to the question of the colour. A glance at the type specimens of the Challenger species shows how variable is the colour of the spicules. The description given by the authors is accurate so far as it goes, but as a matter of opinion it does not appear to me to give enough detail of the differences in colour between branch and branch of the same specimen, or the gradual fading of one colour into another on the stem, as to do full justice to the subject. I think that any impartial naturalist who carefully examined these specimens would say that colour is a character of very little value in the attempt to separate these three species.

It is not my purpose to go fully into the accounts given of the arrangement of the

anthocodiae, the mode of branching, the size of the spicules of the coenenchym and the other characters of the Challenger specimens; but I think it will be found in the future that it is not advisable to recognise in them more than one species. I propose to give a new specific name to the Maldive specimens for various reasons, but I am prepared to admit that the specific distinctions between them and the Challenger specimens are slight and unimportant.

I think, however, it will be found that in the specimens proposed to be named *C. variabilis* the spicules are on an average larger and more regularly arranged in the coenenchym, that the colour, branching and arrangement of the anthocodiae are more irregular (*i.e.* less in conformity with a spiral arrangement), and the anthocodiae rather larger and more retractile than in the Challenger species. It is better, however, to leave the matter in an undecided position until more specimens are obtained from a depth of over 200 fathoms.

The next question is, How are we to distinguish the genus *Siphonogorgia* from *Chironephthya* now that the two characters given by Wright and Studer as diagnostic of the latter genus have broken down?

Having carefully compared the specimens of *Chironephthya variabilis* with *Siphonogorgia mirabilis* from the Maldive archipelago, I would suggest that the name *Chironephthya* be retained for the species or facies with a form and mode of branching resembling that of the genus *Nephthya*, with anthocodiae rarely completely retracted in preserved specimens, and with four principal spicules arranged *en chevron* in the points of the anthocodiae (Figs. 9 and 10); and that the name *Siphonogorgia* be retained for species or facies of more massive *Gorgonia*-like form of growth, with anthocodiae capable of complete retraction within the general coenenchym and with spicules irregularly placed or arranged in a fan-like manner in the points of the anthocodiae (Fig. 11).

As regards the second of these characters it may be pointed out that in *Siphonogorgia pendula* (W. and S.) and the variety of *Siphonogorgia pendula* described by Kükenthal as *ternatana*, the anthocodiae do not appear to be completely retractile. But Kükenthal's variety would be more properly referred to the genus *Chironephthya*, and the type must be regarded as an intermediate form between the two genera which it is convenient for the present to retain in the genus *Siphonogorgia* on account of its *Gorgonia*-like form.

As regards the third character, *Siphonogorgia pendula* (W. and S.) and Kükenthal's variety *ternatana* have the spicules of the "points" arranged in a manner very similar to that of *Chironephthya*. There is no very careful description or figure of this feature, in other species, owing to the retractility of the anthocodiae rendering the observation a difficult one.

In the specimens from the Maldives which I have referred to the species *S. mirabilis* an examination of nearly a hundred anthocodiae showed that only in a few rare cases there are four prominent spicules arranged *en chevron* as in *Chironephthya*; but in the majority of cases there is one prominent median spicule with four or five bent spicules arranged fan-wise on each side of it, as shown in Fig. 11.

The species *Siphonogorgia macrospina* described by Whitelegge (24) from Funafuti from a few fragments appears to me to be more correctly referred to the genus *Chironephthya*.

It is probable from the literature of the subject that in most of the species of *Siphonogorgia* the arrangement of these spicules is similar to this, and it is also probable that this arrangement is intimately associated with the power of retraction of the anthocodiae.

Siphonogorgia mirabilis Klz. (Figs. 11 and 12.) Klunzinger (14) and Kükenthal (15).

Two fragments, A, from Suvadiva Atoll, 25 fathoms across the mouth of the passage, B, from Fadifolu Atoll, 70 fathoms outside atoll N.W. on steep slope.

These two fragments differ in some important particulars from Klunzinger's species and from one another, but it will be more convenient at present to name them *Siphonogorgia mirabilis* Klz., and to point out the chief points of disagreement with the type specimen than to refer them to a new species.

Fragment A from Suvadiva may be only a primary branch of a large colony. It is 110 mm. in length, with nine branches on one side and five on the other. Only one of these branches shows any tendency to further ramification.

In specimen B it is possible we have an almost complete specimen with only the base missing. It is 100 mm. in length, and is very much broken up, but some of the longer branches exhibit secondary and even tertiary ramification.

Both of these fragments have a dirty-blackish crust, formed by an epizoic sponge, covering both stem and branches. In specimen B this crust is so thick on many of the branches and a part of the main stem as to completely hide the red colour of the coenenchymal spicules, but in A the red colour can be seen through the sponge, as also in the main stem and some of the branches of B. The sponge belongs to the genus *Halisarca*, and I am informed by Professor Topsent it probably belongs to the species *H. Dujardini*. In both specimens anthocodiae can be clearly seen, and are particularly noticeable owing to their bright yellow colour.

The specimens agree with the original specimen of *Siphonogorgia mirabilis* in the following particulars.

The colonies branch in one plane, sometimes dichotomously. The stem and branches are almost cylindrical, the finest branches irregularly angular. The extremities of the finer branches are blunt, and bear from 4—6 anthocodiae. The anthocodiae occur on all sides of the branches and twigs, but are scarce on the larger branches, and fail altogether on the lower part of the stem (specimen B).

The spicules of the coenenchym are spindles covered with warts and knobs, and of a deep red colour. They are irregularly arranged on the main stem and larger branches, but almost parallel with the axes on the smaller branches. The spicules of the anthocodiae are yellow in colour, slender spindles, with sparse warts and tubercles.

The most important point of difference to be observed between the Maldive forms and the type lies in the size of the spicules. According to Klunzinger the largest spicules of the coenenchym are 0·5 mm. × 0·128 broad. In the Maldive forms some of the largest spicules are 4 mm. × 0·2 mm., but the average is about 2 mm. × 0·15 mm. The size of these large spicules varies so much in some of the species that it is doubtful whether much reliance can be laid upon the figures given by some authors as being by any means exclusive. Kölliker in his original description of *Siphonogorgia godeffroyi* states that the spicules vary from 1—4 mm. in length. In the Challenger series the sizes of these spicules are given by Wright and Studer as follows, *S. pallida* 2 × ·3, *S. pustulosa* 2 × ·38, *S. pendula* 2·8 × ·224, *S. Köllikeri* 1·2 × 0·2, and the spicules of Kükenthal's species were *S. cylindrata* 3·7 × 0·4, *S. miniacea* 1·3 × 0·14. It is to be observed, however, that in none of the descriptions of the species these spicules are said to be so small as 0·5 mm. in length as stated to be the case by Klunzinger in *S. mirabilis*. From the fact that Klunzinger's excellent work is unfortunately hampered by many

misprints, coupled with a study of the lowermost of his four figures marked *d*, which appears to be the point of a large spicule 2 or more mm. in length, and that the author does not comment on the small size of these spicules as compared with those of *S. godeffroyi*, a doubt may arise as to whether 0·5 mm. in his description is not a misprint for 5 mm.

Even if the spicules are so small as they are stated to be in Klunzinger's specimen it does not seem to me that this is a sufficient reason for making the Maldive specimens into a new species. The size of the spicules of Alcyonarians varies very much in different localities and conditions of growth, and there might well be a considerable range in this respect in one species that occurs over such a wide range as the Red Sea and the Maldives.

Klunzinger makes a note at the end of his description that "Beim Trocknen tritt die Bindesubstanz durch ihre weisse Farbe vor und giebt dem Ganzen ein staub- oder schaumartiges Ansehen oder wie weiss und roth gesprenkelt und das Roth tritt zurück."

I have found that on drying a small portion of one branch of specimen B that the encrusting sponge turns white, and gives the specimen very much the appearance described by Klunzinger. It is quite possible, therefore, that what this author describes as the superficial connective tissue is in reality an encrusting sponge.

The bright yellow colour of the spicules of the anthocodiae which forms such a very conspicuous feature of these specimens is a minor point of resemblance with the type of *S. mirabilis*. In *Siphonogorgia pustulosa* (W. and S.) we have a similar combination of yellow spicules in the anthocodiae with red spicules in the coenenchym. In *S. cylindrata* (Kük.), the spicules of the anthocodiae are also pale yellow, the spicules of the rest of the colony being yellow.

The slender spicules of the crown and points of the anthocodiae vary in size, but average about ·3 mm. in length, *i.e.* only a trifle longer than those of the type specimen. The arrangement of the spicules in the points, *i.e.* on the aboral side of the tentacles, has been described above under the genus *Chironephthya*.

The geographical distribution of the genus *Siphonogorgia*, as it is at present known, is interesting. Specimens have been obtained from the Pelew Islands, Ellice Islands (Funafuti), N.W. Australia, New Hebrides, Malay archipelago, and one specimen hitherto found in the Red Sea. The discovery of *Siphonogorgia* in the Maldives fills up a gap between the extreme East and West limits, and suggests that it may occur in other suitable localities of the Indian Ocean.

Family **Briareidae.**

Genus *Solenocaulon* (Gray).

The general features of this genus were first described by Gray (8). Subsequently Genth (6) described with considerable detail an Alcyonarian from the Philippines, which he named *Solenogorgia tubulosa*. Later on Studer (21) in describing a new species (*Solenocaulon grayi*), gave reasons for including Genth's specimen in Gray's original genus *Solenocaulon*. Six years ago Germanos (7) in his paper on the Gorgonacea of Ternate gave a historical review of the genus, and added three new species.

In Germanos' interesting and important contribution to our knowledge of the genus he proposed to arrange the six known species into two groups as follows:

1. Sub-genus *Sclerosolenocaulon.*

Solenocaulon tubulosa, Genth.

Solenocaulon sterroklonium, Germ.

Solenocaulon diplokalyx, Germ.

2. Sub-genus *Malacosolenocaulon.*

Solenocaulon tortuosum, Gray.

Solenocaulon akalyx, Ternate.

Solenocaulon grayi, Studer.

A careful consideration of Germanos' laborious investigation in the light thrown upon the subject by Mr Gardiner's fine collection and the type specimens in the British Museum has led me to the conclusion that this arrangement of the species is not satisfactory. The first and most important character that is used by this author for the separation of the sub-genus *Sclerosolenocaulon* from *Malacosolenocaulon* is the presence of a stalk. It appears to me to be still a matter of doubt whether there are any specimens of *Solenocaulon* without a stalk, since the original specimen described by Gray certainly has a stalk, which is solid, and the specimen attributed to the same genus by Studer was incomplete at the base, and therefore afforded no evidence on the subject. The specimen upon which Germanos bases his species *S. akalyx* consisted only of "zwei grosse Stücke," and as no description, figure, or even statement is given of the base of attachment, it is reasonable to suppose that it was missing. The stalk is also missing in the only specimen that has hitherto been described of the species *S. grayi,* Studer. It is difficult to understand how Germanos could have overlooked these facts in drawing up his classification, unless it is supposed he uses the word stalk "Stiel" in a sense which is not usual. As regards the character of the axis which plays an important part in this classification, I may say that Studer's description of the axis "aus durch Hornmasse verbundenen, losen, spindel-förmigen Spicula bestehen" accurately describes the axis of Mr Gardiner's specimens. I cannot understand what is meant by the statement that in the branches of *Solenocaulon tubulosa, S. sterroklonium,* and *S. diplokalyx* the spicules are fused to form a solid axis. If we are to understand that the calcareous spicules are fused together to form a solid calcareous rod as in the axis of *Corallium* or the tubes of *Tubipora,* then it may be regarded as a character of specific or even of sub-generic importance, but Germanos brings little evidence to prove that this is the case. In many of the smaller branches of my specimens I find the spicules of the axis so tightly packed together as to form a porous calcareous rod as figured by Genth, which does not break up on boiling in 5 °/₀ potash, but as Genth adds, "Die verschmolzenen Spicula gehen ohne merkliche Grenze in die freien über." Whether the spicules do or do not become so tightly packed as this in the branches depends upon the rapidity of growth of the individual branch, and is not of the slightest systematic importance. If the spicules fused in some forms to form a solid axis in the stem or stalk and not in others, we should have a character of prime importance, but the axis of the stem and stalk is admittedly the same in all species.

The species *Solenocaulon tortuosum* Gray and *Solenogorgia* (*Solenocaulon*) *tubulosa* Genth differ from one another principally in the fact that the latter gives off from the main tubular stems several short grooved blunt branches bearing numerous anthocodiae. In the

former these branches are rather longer and narrower. In *S. grayi* (Studer) the grooved branchlets are much longer, more delicate, and pointed or knobbed at the extremity. *S. tubulosa* is therefore as regards its form intermediate in character between *S. tortuosum* and *S. grayi*. If we eliminate these characters of form there is, it appears to me, very little to distinguish the species. Now in considering the growth of a form like this we must not leave out of consideration the fact that spirit specimens prove that usually and perhaps always, the tubes of *Solenogorgia* contain epizoic Crustacea belonging to the genus *Alpheus*. The general appearance of the groove on one side of the non-tubular terminal branchlets, in specimens similar in form to that described by Studer as *S. grayi*, suggests that these Crustacea are in the habit of running along them in search of food, and retreating to the tubular parts for protection. The general characters of the groove are the smoothness of the surface as compared with the outer convex side of the branch, the absence of anthocodiae, and the relatively pale colour. These are characteristics which we should expect to find if any part of the surface of a coral were constantly irritated by the feet of an active little crustacean. Now it is well known that in many forms of corals such as *Pocillopora*, *Seriatopora*, *Millepora*, etc. one effect of a symbiotic crab on the growth is the formation of a spherical or oval gall, the margins of the affected part being hypertrophied and growing round and enclosing the animal that causes the irritation. Similarly, barnacles of various species cause gall-like growths of the coenenchym in various *Madreporaria*, *Millepora*, *Gorgonia*, and other *Alcyonaria*. An examination of the surface enclosed or about to be enclosed by the galls of *Pocillopora*, *Seriatopora*, and *Millepora* shows a smoothness of the surface, and, in *Millepora*, an absence of polyps similar to that shown in the groove of the *Solenocaulon* branchlets.

It appears to me therefore very probable that the tubular character of *Solenocaulon* is of the nature of a gall produced by an active crustacean, and that the degree to which it affects the secondary and tertiary branches depends, not upon any inherent specific character of the *Solenocaulon*, but upon the number or activity of the symbiotic crustacea.

Whether this explanation is true or not, it is not satisfactory from a systematic point of view to distinguish as distinct species specimens which differ from one another principally in their form of growth. The many striking similarities that there are between *S. tortuosum* of Gray, *S. tubulosa* of Genth, and *S. grayi* of Studer in the shape and arrangement of the spicules and other characters suggest very forcibly that they all belong to one widely distributed species.

This conclusion receives considerable support from the examination of the very rich and interesting collection of the specimens of this genus made by Mr Gardiner, and I shall therefore place them all, except one which I believe to be the type of a new species, in one species.

Solenocaulon tortuosum Gray. (Fig. 13.)

It will be convenient to give in the first place a list of the specimens, with a short description of each one.

A. A small specimen of a pale pink colour. About 145 mm. in height. Stalk 75 mm. long, 5 mm. in diameter. Most of the lateral flattened branchlets short. Suvadiva, 43 fathoms. Lagoon. Hard rubble.

B. A dried specimen rather broken, but of approximately the same size and form of growth as A. Pale cream colour. Suvadiva, 37 fathoms. Near a passage. Hard sand.

C. A specimen about 170 mm. in height with axis divided into two main branches (Fig. 13). Stalk 60 mm., bifid at base. There are few narrow grooved branchlets. Colour, orange-brown. Suvadiva, 38 fathoms. In a passage. Rubble bottom.

D. Two fragments, with rather longer grooved branchlets than in A. Colour, a rich pink, darker in tone than A. Fadifolu, off W. side, 22 fathoms. Weed, sand, and small coral.

E. A specimen in fragments. It was probably twice as large as A when complete. In this there are several long, deeply grooved branchlets over 15 mm. in length. The parts that form complete tubes are very restricted in extent. Dull pale brown in colour. Mulaku, 22 fathoms. Weed and sand.

F. Another somewhat smaller specimen, with several very long almost flattened branchlets. None of the branches among these fragments show the completely tubular condition. Colour, dull pink. Mulaku, 32 fathoms. Mud, weed, and sponges.

G. A specimen also in fragments, with several fairly long grooved branchlets, but freely tubular on the branches. The colour varies from dull pink to dull pinkish brown. S. Male, 28 fathoms. Hard white sand.

H. A complete specimen. About 180 mm. in length, with a very long stalk broken at the extremity and a divided axis as in C (Fig. 13). Very few long grooved branchlets. Freely tubular. Colour, pinkish brown. Stalk fading to white at base. S. Nilandu, 25 fathoms. W. of atoll.

K. The largest specimen in the collection, but very much broken. The stalk is relatively short. The axis and primary branches form complete tubes throughout nearly the whole of their extent, but there are some large projecting flattened or grooved branchlets 80 mm. and more in length. The colour is brown. N. Male, 27 fathoms. N. of atoll. Broken shells.

L. A small fragment of the same general character as K, but rather more pink in colour. N. Male, 28 fathoms. Near shoal, W. centre. Sand.

M. A very small fragment of same general characters as K, but bright orange in colour. Mahlos Atoll, 23 fathoms. Passage. N.E. lagoon.

In this series of specimens from the same group of islands we have a series of links connecting together the well-known and well-described species belonging to the genus. The careful examination of the specimens A, B, and C from Suvadiva, and a comparison of the spicules and tentacles, sections of the stalk and axis with the description given by Genth convinced me that these specimens belong to the species *S. tubulosum*.

A comparison however of specimens G and K with the type specimens of *S. tortuosum* in the British Museum exhibited no differences either in general mode of growth or spiculation that would justify a separation of them from the original species.

The fragment L moreover exhibits branches which have a remarkable resemblance in their form and the manner in which the anthocodiae are distributed upon them to those of Studer's species *S. grayi.*

The specimen F from Mulaku I should place with Gray's species *Leucoella cervicornis,* were it not for specimen E, which is intermediate in character between *Leucoella cervicornis* and *Solenocaulon grayi.* The spicules of F cannot be distinguished from those of the type specimen of *Leucoella cervicornis.* The other specimens cannot be so easily placed in any known species, but appear to form intermediate stages of growth or modification between those already referred to. It appears to me that the facts above mentioned point to the conclusion that all these specimens of the genus *Solenocaulon* from the Maldives belong to one species, and by the general custom of priority should be referred to Gray's species *Solenocaulon tortuosum.* Such a conclusion, however, would not be justified without reference to other characters than the mode of growth.

That there are differences between the spicules in my preparations cannot be denied, but when due allowance is made for the variation in size and shape of the spicules of the various parts of one specimen there remains such a strong family likeness between them all, including *Leucoella cervicornis,* that the differences cannot be expressed in words or figures. When the different accounts of the spicules of the genus are compared there is a surprising similarity rather than difference in their character to be noticed. I have collected, for example, the length-measurements given of the long-thorned spicules of the axis, and they are as follows.

S. tubulosum (Genth) 0·36 circa. *S. grayi* (Studer) 0·37—0·4. *S. tortuosum* (Studer) 0·3—0·4. *S. tortuosum* (Ridley) 0·38. *Leucoella cervicornis* (Ridley) 0·35—0·42. *S. sterroklonium* (Germanos) 0·2—0·38. These figures are sufficient to show that in the matter of this measurement there is a remarkable uniformity even in specimens so far apart as Torres Straits and the Maldive archipelago, and as other measurements show corresponding results the spicules do not afford sufficient grounds for splitting the genus up into species.

The next feature it was necessary to investigate was the character of the verrucae. I carefully selected branches from several of the specimens from the Maldives, and dried them slowly by exposure to the air in the laboratory, and then examined them with a 1 inch objective. In all cases some of the polyps were contracted so much that the spicules of the tentacles were below the level of the verrucae. In others which were not so completely retracted there could be seen an arrangement of the spicules at the back of the tentacles and in the neck of the anthocodiae (*i.e.* what I have called on p. 488 the crown and point spicules) similar to that described and figured (Fig. 17) by Genth. Another point of considerable importance I found in studying one of the polyps of a specimen, and that is the presence of rough and somewhat irregular spindle-shaped spicules supporting the pinnules, in the manner described and figured by Genth, 0·2 mm. in length. The presence of these spicules in Genth's specimen from the Philippines, and in this specimen from the Maldives, is especially noteworthy.

In conclusion I may say that I propose to name the specimens of *Solenocaulon* in the collection as follows:

A B C *Solenocaulon tortuosum,* Facies *tubulosum* Genth,
D G H K M *Solenocaulon tortuosum,* Facies *tortuosum* Gray,
L E *Solenocaulon tortuosum,* Facies *grayi* Studer,
F *Solenocaulon tortuosum,* Facies *cervicornis* Gray.

Solenocaulon ramosa. New species. (Figs. 14, 15, 16, 17.)

Locality. Suvadiva Lagoon. Coarse sand and rubble. 39 fathoms. One specimen.

With the usual system I have little doubt this specimen would be made the type of a new genus, but after the examination of the other specimens of the genus it is only with some hesitation that I propose to constitute a new species for it.

The characters by which it is distinguished from all the other specimens of *Solencaulon* in the collection, and indeed from the other described species of the genus (including *Leucoella*), might be accounted for as local variations. But, bearing in mind, that no less than three specimens A, B, and C of the ordinary kind came from the Suvadiva lagoon at the same depth, this consideration loses a great deal of weight. Nevertheless it is just possible that the character of the currents at the spot where this was found influencing the symbiotic crustacea in some way or another may have produced this abnormal form of growth. It is possible that a different and larger species of crustacean may have sheltered in the branches, driving away the normal species, thereby causing the large belt-like shelters, and preventing the formation of the narrower tubes. I do not think that any such causes are so likely to have affected the other features in which it differs from the other specimens of the collection.

The specimen is very much broken, but by putting the fragments together I have reckoned that when taken it was about 280 mm. in height. It is probable, however, that this measurement is considerably short of the total length of the specimen when it was alive. There is no stalk or base of attachment.

The most characteristic feature of the specimen is the presence of three complete belts, and one incomplete belt on the axis, and one incomplete belt on a branch. These belts are formed in the same manner, and have the same significance as the tubes of *Solenocaulon tortuosum.* They are simply flattened wing-like outgrowths from the axis or branch which embrace a cavity and fuse where they meet at their extremities (Figs. 15, 16).

These belts are from 15—20 mm. in diameter above, and from 22—23 mm. in diameter below, and about 20 mm. in length. They are situated on the axis at intervals of about 30 mm. The incomplete belts are very similar to the complete ones in size and form, but the sides are not fused opposite to the axis.

In one or two of the fragments there are places where a branch is very much flattened and expanded, and these are undoubtedly to be regarded as commencing belts (Fig. 15).

Unfortunately there is no direct evidence as to what these belts contained, but it is very probable that they sheltered some epizoic crustacean or other animal. The resemblance of the imperfect belts to the growing crab-galls of a *Seriatopora* or *Pocillopora* is very striking.

In its thickest part (nearest to the missing stalk) the axis is roughly cylindrical in form, and about 8 mm. in diameter. It is scored with irregularly arranged longitudinal grooves. Above the lowest belt it is more flattened, and about 5 mm. in thickness, but from this point upwards the extent of flattening is very irregular, some parts being much broader than others.

The structure of the axis appears to be precisely similar to that of *S. tortuosum,* the corky substance of the central part and the softer vascular bark having the same general appearance in the two species.

The spicules of the axis and of the branches are so remarkably similar to those of the other species that I cannot distinguish them. A very striking feature, however, of the new species is the fact that none of the polyps are completely retracted into the verrucae, and this gives the specimen a much more spiny or hirsute appearance.

The incomplete retractility of the polyps is due to the fact that the spicules of the crown and the points are not only more numerous and therefore more closely set, but distinctly thicker than they are in the other species.

I have very carefully compared some polyps of nearly all the specimens of *Solenocaulon* from the Maldives, and in none of them could I find the same number or character of these spicules as in the new species.

The pinnulae of the tentacles are supported by spindle-shaped spicules, but these again are stouter than in the corresponding spicules of *S. tortuosum.*

The colour of the specimen is dark brown. It will be observed that this colour is very different to the pale pink, cream, and orange colours of the other specimens of *Solenocaulon* from Suvadiva.

Family **Melitodidae.**

Preliminary note on the genus **Melitodes** (Verrill).

In the collection from the Maldives these several specimens belonging to the genus *Melitodes* and the species problem presents itself again with exaggerated difficulties.

The specimens are all very brittle and considerably broken, so that the exact form of the whole colony is difficult to determine, but exceedingly well-marked differences between individual specimens can be observed in the size of the nodes, the length and thickness of the internodes, and the colour of both nodes and internodes.

From Hulule, Male Atoll, alone I have already noticed the five principal varieties given in the following table.

	Nodes		Internodes		
	Colour	*Diameter*	*Colour*	*Length*	*Diameter*
1	Yellow	4 mm. swollen	Red	7—13 mm.	2 mm.
2	Yellow	2 mm. not swollen	White	22—24 mm.	2 mm.
3	Red	1 mm. swollen	White	5 mm.	0·5 mm.
4	Yellow	3 mm. slightly swollen	Pink	15 mm.	2 mm.
5	Red	1 mm. slightly swollen	Gray	10 mm.	0·75 mm.

From Addu Atoll. There are four varieties, apparently quite distinct from one another and from the Hulule, Male, varieties.

From these two atolls no less than nine species might be made which could be fairly well defined by measurements of nodes and internodes and by colour; but on the other hand the three or four varieties from Miladumadulu, one from North Male, two from Suvadiva, and one from Felidu, make up a series which is almost complete between the extremes. The examination of the spicules does not help us in the matter very materially. There is so much variation in the size and shape of the spicules in every individual specimen that the comparison between one specimen and another is very difficult, but of the many preparations of spicules that I have made there is not one that can be recognised as belonging to a distinct form of growth. The preparations prove that the spicules of all varieties have a general family resemblance, but beyond that it is impossible to speak definitely.

The problem, however, is complicated in this case by the fact that Mr Gardiner from observations on the reef came to the conclusion that there is more than one species. I feel, therefore, that it is necessary, before definitely expressing my own opinion, to submit some of the specimens to a further anatomical examination. The publication at the present moment, however, of the fact that this interesting series of *Melitodes* varieties does occur, appears to me to be advisable, although the detailed description of them must be necessarily delayed.

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PLATE XXVI.

Fig. 1. *Telesto rubra*, n. sp. A portion of a colony with four secondary branches (*b*). At *v.v.* are seen the verrucae of the lateral polyps. *g.* a barnacle gall. All the parts that are shaded are covered with the encrusting sponge *Prosuberites*, which is coloured blue-green with Beggiatoaceae. The unshaded parts show the red colour of the skeleton through a very thin lamina of the sponge. × 1½ ca.

Fig. 2. A portion of the calcareous skeleton of *Telesto rubra* after treatment with caustic potash to show the ridges (*r.r.*) and the irregular perforation of the tubes.

Fig. 3. Side view of one of the tentacles of *Telesto rubra* to show the eight pinnae (*p.p.*), each supported by one spicule, and the smaller spicules supporting the axis of the tentacle *sp.*

Fig. 4. One of the spicules of the pinnae of *Telesto rubra* isolated. × 200.

Fig. 5. One of the red spindle-shaped spicules of *Telesto rubra* at the base of the anthocodia, which increase rapidly in size, fuse, and form the solid tubular skeleton. × 200.

Fig. 6. Two spicules of the same region of *Telesto rubra* very much younger and smaller than the one in Fig. 5. × 200.

Fig. 7. A characteristic spicule of *Telesto trichostemma*. × 150.

Fig. 8. *Chironephthya variabilis*, n. sp. A sketch to show the general form of the colony. × 1½ ca.

Fig. 9. An anthocodia of specimen D of *Chironephthya variabilis* showing the arrangement of the spicules in the crown (*C*) and points (*P*). This arrangement is characteristic of what appears to be young polyps.

Fig. 10. An anthocodia of specimen E of *Chironephthya variabilis*, showing the spicules in both crown (*C*) and points (*P*) larger and more crowded than in specimen D.

Fig. 11. Arrangement of the spicules in the points of *Siphonogorgia mirabilis*, showing one prominent median spicule and the others smaller and arranged in the manner of a fan on each side of it.

Fig. 12. A small piece of the terminal branch of *Siphonogorgia mirabilis*, the surface being covered with the sponge *Halisarca*. *Sp.* cut edge of the sponge. *Coen.* the large spicules of the coenenchym as seen when the sponge is scraped off. *Anth.* anthocodiae projecting through the sponge.

Fig. 13. *Solenocaulon tortuosum* Gray. Specimen C from Suvadiva. Nat. size. It shows *t.* the tubular secondary branches, and *b.b.* the very short free terminal branchlets.

PLATE XXVII.

Fig. 14. *Solenocaulon ramosa*, n. sp. A small portion of a large colony. It shows at *B.B.* two large belt-like growths on the main stems, and at *b.b.* the long free terminal non-tubular branches.

Figs. 15, 16. Two stages in the formation of the belts of *Solenocaulon ramosa*.

Fig. 17. A terminal branch of *Solenocaulon ramosa*, n. sp., showing the non-retractile anthocodiae, *Anth.*

Fig. 18. A terminal branch of *Solenocaulon tortuosum* from the Maldives for comparison with Fig. 17.

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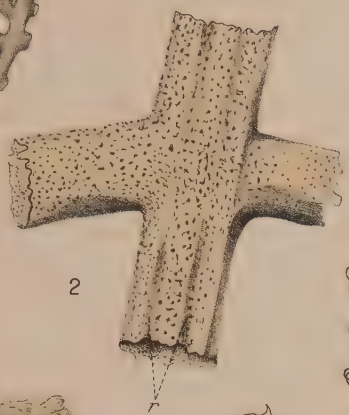

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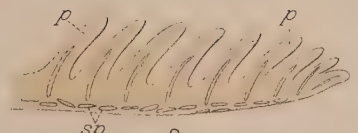

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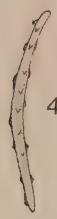

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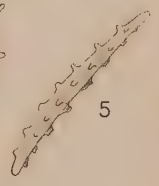

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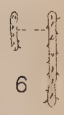
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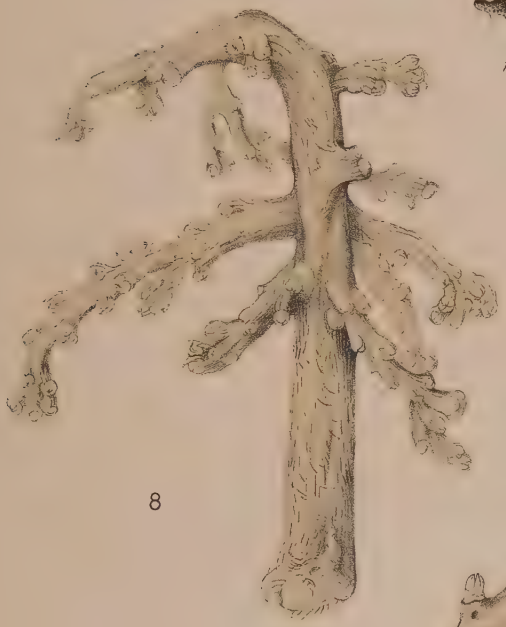

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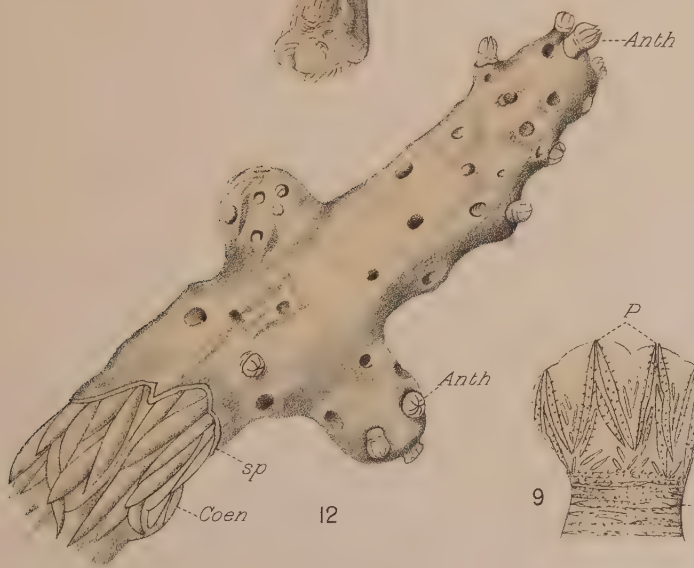

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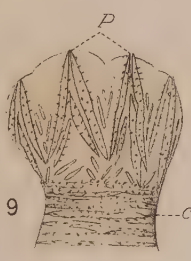

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F. M. D. del. E. Wilson, Cambridge.

Hickson – Alcyonaria.

THE ALCYONARIA OF THE MALDIVES.

PART II.

THE GENERA SARCOPHYTUM, LOBOPHYTUM, SCLEROPHYTUM, AND ALCYONIUM.

By Edith M. Pratt, M.Sc. Vict., *Late Honorary Research Fellow of the Owens College, Manchester.*

(With Plates XXVIII—XXXI.)

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I. INTRODUCTION.

The genus *Sarcophytum* was founded by Lesson in 1831, its distinguishing feature being the mushroom-shape of the colony. Klunzinger in 1877 included in the genus a form which is not mushroom-shaped, and which he termed *Sarcophytum pauciflorum*. Marenzeller in 1886 separated those forms which are mushroom-shaped from those which are not, and for the reception of the latter he established the genus *Lobophytum*, of which he described several new species. This genus was based upon the form of the colony, the dimorphic character of the zooids, and the form and size of the spicules.

When examining examples of several species in the collection which have been attributed to *Lobophytum*, I observed that while all the specimens have the lobed form characteristic of the genus, some differ from others in that they are extremely hard and brittle. This I found is due to the presence of enormous spicules which occur throughout the colony in very considerable numbers. In some cases siphonozooids were observed to be very minute, and could only be distinguished with the aid of the microscope, while in a few instances they were apparently absent.

In addition to the abundant supply of excellently preserved material in the collection from the Maldive Islands, the zoological laboratories of the Owens College contained other collections of similar material, which through the kindness of Professor Hickson were placed at my disposal. These included Mr Stanley Gardiner's collection from Funafuti, Dr Willey's collection from New Guinea, New Britain and Lifu, and Professor Haddon's collection from the Torres Straits. I have also been allowed to make a cursory examination of Professor Herdman's collection from Ceylon. It was, therefore, possible for me to make an investigation of the anatomy of the genus *Lobophytum*, which hitherto had not been attempted, and also to make a comparative study of the anatomy of many species, which have been attributed to this genus, from many different localities. The general results of these investigations are contained in the present paper. A more detailed account of the comparative minute anatomy will, I hope, be published later.

An interesting and important result of my research was the discovery of a large and extremely well-marked *superficial canal system* in those species of the genus *Lobophytum* with *minute siphonozooids*, which occurs also in those with apparently *no siphonozooids*. In the former this canal system was observed to be in intimate connection with the minute siphonozooids, but it is absent or only very feebly developed in those species with large siphonozooids. Further investigation led me to the conclusion that the present definition of the genus, which is based upon the form of the colony, dimorphism and the character of the spicules, is artificial and inefficient, because it is founded upon insufficient evidence.

All the species of the genus *Lobophytum* divide naturally into two groups; one includes all those species whose anatomy is similar to the species *pauciflorum*, which has no special superficial canal system, but is provided with comparatively large siphonozooids; the other group includes all the remaining species of the genus, whose general anatomy is similar to that of the species *densum*, a form with minute siphonozooids and a large superficial canal system. The important differences between the two groups of species clearly indicate that they are genetically as distinct from each other as each is distinct from the genus *Sarcophytum* or any other genus of the Alcyonaria. It is, therefore, necessary to separate the

group of species with minute siphonozooids from the genus *Lobophytum*, and to establish a new genus for its reception. The characteristic hardness of many of the species suggests the generic title *Sclerophytum*.

In the collection from the Maldive Islands were young colonies of *Lobophytum pauciflorum* (fig. 12) and *Sclerophytum densum* (fig. 18), which were mushroom-shaped. Several similar colonies of *Lobophytum* and *Sclerophytum* occur also in Professor Herdman's collection from Ceylon. The mushroom-like form of young specimens of these two genera is interesting, and may lead to confusion in the identification of the genus, for the mushroom-like form of the colony is held to be characteristic of the genus *Sarcophytum*. We have now evidence, however, that it is not confined to that genus.

It has already been shown that well-grown specimens of *Lobophytum* and the new genus *Sclerophytum* may be very similar in form and appearance, but very different in anatomical structure. Specimens of *Sclerophytum* occur also in the collection, which differ considerably in outward form, but which are identical in structure (*Sclerophytum durum*, figs. 29 and 30). The form of the colony alone cannot, therefore, be recognised as a generic or even a specific character.

In many cases the spicules of *Sarcophytum*, *Lobophytum*, and the new genus *Sclerophytum* are distinct from each other, and may be easily recognised, but this cannot be regarded as an established rule, for the zoned spicules supposed to be characteristic of *Lobophytum* occur also in *Sarcophytum latum* and *roseum* (sp. nov.); the tuberculate spicule occurring throughout *Sclerophytum* is to be found also in *Sarcophytum* in the species *plicatum*, *boettgeri*, and apparently in *nigrum*.

The following species which I have examined would be retained in the genus *Lobophytum*:—*pauciflorum*, *crassum*, and *hedleyi*. The new genus *Sclerophytum* (p. 516) will include the species *densum*, *confertum*, *marenzelleri*, *tuberculosum*, which have hitherto been attributed to *Lobophytum*.

All the specimens of the Alcyonidae in the Maldive Islands collections were examined for reproductive organs. In the majority of cases they were apparently absent. The remaining specimens contained ova usually exhibiting several stages of development in a single colony. There does not appear to be a single specimen with male cells in the whole collection.

II. GENUS SARCOPHYTUM (Pl. XXVIII. figs. 1—6, 9—11).

This genus was first founded by Lesson in 1831 (p. 92), and forty-four years appear then to have elapsed without any further account of it. Moseley in 1875 (p. 19, Pl. VIII. fig. 2, Pl. IX. fig. 9) carefully described the general anatomy of a species belonging to this genus. Lesson's definition was amended by Marenzeller, 1886 (p. 351), and again by Wright and Studer, 1889 (p. 244).

After carefully comparing in detail the anatomy and histology of several species included in the genus I find that Wright and Studer's definition holds good, as far as it goes, for all the species which I have examined. It is necessary to mention, however, that the mushroom-like form of the colony is not confined to this genus, but occurs among young specimens of the genera *Lobophytum* and *Sclerophytum*. Moseley's account of the general

anatomy is valuable as a basis for the comparison of other species, and is of material assistance in the establishment of certain generic features.

Six species of *Sarcophytum* occur in the collection from the Maldive Islands, three of which have been recorded from other localities, one is a new variety of an old species, and two species are new. The species are:—*glaucum*, *latum*, *boettgeri*, var. nov., *roseum*, sp. nov., *tenuis*, sp. nov.

Siphonozooids. Owing to the difference in contraction of preserved specimens it is difficult to obtain any specific standard of measurement of the autozooids. A series of measurements of the siphonozooids of several specimens belonging to the same species, however, show them to be of almost uniform size. The size of a siphonozooid in the preserved condition therefore appears to be almost constant for a species, and may be looked upon as a specific character. The length of the stomodaeum of a siphonozooid varies to a certain extent in different species, but is almost constant for a single species. It will be seen from the appended table that the stomodaeum of the siphonozooids is an important factor in the determination of the species[1].

	S. glaucum	*S. ehrenbergi*	*S. latum*	*S. plicatum*[2]	*S. tenuis*	*S. roseum*
Surface diameter of siphonozooids	·2 mm.	·37 mm.	·33 mm.	·3 mm.	·3 mm.	·45 mm.
Transverse length of stomodaeum	·1 mm.	·18 mm.	·1 mm.	·1 mm.	·1 mm.	·12 mm.
Vertical length of stomodaeum	·16 mm.	·32 mm.	·3 mm.	·28 mm.	·2 mm.	·4 mm.

By introducing lamp-black into the sea-water about living colonies of *Sarcophytum*, Mr Gardiner observed currents entering the siphonozooids. After some time the blackened water was ejected by the autozooids, and in some cases by the same siphonozooids, showing that a reversal of the current had taken place within the colony.

The presence of numerous, well-marked, and regularly arranged siphonozooids in this genus as well as in the amended genus *Lobophytum*, enables the effectual aëration of the superficial portions of the colony, where metabolism is greatest, and is doubtless correlated with the absence of a special superficial canal system so well marked in *Sclerophytum*, in which the siphonozooids are very minute.

Autozooids. The autozooids are large, and are very similar to those of *Lobophytum*. The *tentacles* are much shorter and broader in proportion to their length than those of *Alcyonium*. They are of the simple pinnate character, with a single row of pinnules down each side. In some cases the pinnules are so small as to be easily overlooked. They are very similar to those of *Lobophytum*.

The *stomodaeum* is usually long and in the preserved state is convoluted. The *siphonoglyph* is not well-marked in any of the specimens in the collection, and can only be

[1] The measurements were obtained by measuring several siphonozooids from different parts of a colony and taking an average.

[2] *S. plicatum* was not in the collection from the Maldive Islands.

distinguished in stained preparations. The *mesenteries* are large and well developed in all the species which I have examined. The ventral and lateral mesenteries are provided with very stout, rounded mesenterial filaments, which are similar to those of the genus *Lobophytum*, but are larger and much more strongly marked than in the genus *Sclerophytum*. The dorsal mesenterial filaments are very long, and are grooved and ciliated as in many other genera of the Alcyonaria.

Zoochlorellae are fairly numerous in the endodermal tissues, canals and zooid cavities in all the species. In addition, rounded cells of a yellow colour occur in *glaucum* and *latum*.

Canal System. The canal system of this genus has been described and figured by Moseley (1881). It is similar to that of *Lobophytum*, but differs from *Sclerophytum* in the absence of a special superficial system. It is to a certain extent homologous with the internal system of *Sclerophytum*. In *Sarcophytum* the principal longitudinal vessels are direct prolongations of the siphonozooids. In *Sclerophytum*, however, the siphonozooids terminate in the large vessels of the special superficial canal system, and as a rule are only indirectly connected with the longitudinal vessels of the internal canal system (p. 519).

The longitudinal vessels run more or less parallel with the longitudinal axis of the autozooids, and send off numerous branches, which may terminate in the coelenteric cavity of a neighbouring zooid, or ramify and anastomose in the substance of the mesogloea, and form a complete network. Some of the branches end in solid cords and strands in the mesogloea, in a manner described by Ashworth in *Xenia* (1899, p. 190). The strands and cords are not indicated in Moseley's figure. I found it impossible to perceive cilia on the walls of the vessels of the canal system.

In addition to this system of canals neighbouring autozooids are connected by means of short, straight canals which are provided with fairly long cilia (fig. 3). These vessels are described and figured by Moseley, but are not described as being ciliated. I have observed similar ciliated vessels in *Lobophytum*, in living *Alcyonium*, in which they are less numerous, and in *Sclerophytum*, in which they are very few in number.

Growth. In all the species of the genus which I have examined the autozooids are most numerous at the margin of the capitulum (fig. 1), but in this portion of the colony they are usually smaller and appear to be younger than elsewhere. Growth, by the budding of new autozooids, is most vigorous in the same part. Where it is very rapid the margin is often thrown into folds as in Schenk's figure *S. plicatum* (1896, Taf. II. fig. 12). Often a young colony can be distinguished from an older one by the rounded, unbroken contour of the margin, but in both specimens of *tenuis*, which have attained a considerable size, the capitulum is flattened, slightly concave, and the margin unbroken by folds (fig. 9). The siphonozooids are not very numerous at the margin, but are most common in the middle of the capitulum. They are apparently budded off from the endodermal canals usually in the proximity of the food-supplying autozooids. Young specimens of *Sarcophytum* and *Lobophytum* are usually mushroom-shaped, and are very similar in appearance, so that at first sight a young *Lobophytum* may be easily mistaken for a *Sarcophytum*. After carefully examining all the young specimens in this and in the other collections I find in every case that in *Sarcophytum* autozooids are most numerous at the margin of the capitulum (fig. 1), while in *Lobophytum* autozooids are least numerous, and siphonozooids most numerous at the margin (fig. 7). As growth of the capitulum proceeds in both genera chiefly by the budding of new autozooids, the growth of the colony in *Sarcophytum* is most vigorous at the edge

of the capitulum, so that the colony retains its mushroom-like form throughout life. In *Lobophytum*, however, new autozooids are formed from any portion of the capitulum, and growth at the margin where autozooids are fewest is necessarily very slow, consequently as a colony grows it loses its primitive mushroom-shape and assumes a lobulated appearance[1].

1. *Sarcophytum ehrenbergi* (Pl. XXVIII. figs. 1 and 2). Marenzeller, 1886 (p. 356, Taf. IX. figs. 3 and 4).

Four small specimens were taken on the reefs at Hulule, Male Atoll, and two larger incomplete specimens at Goidu, Gorfurfehendu Atoll.

All the specimens agree fairly well with Marenzeller's description. The margin of the capitulum in young specimens is incurved, rounded and unbroken, in older colonies it is often convoluted. The colour in spirit is light greenish-brown. The autozooids are large and well-marked, and are more numerous round the margin, but this character is not so strongly marked as in *tenuis* (fig. 9) and *latum*.

Autozooids. The anthocodiae of fairly expanded autozooids are about 5 mm. in length. The surface diameter of an autozooid cavity is ·8 mm. The tentacles are short and pinnate (fig. 2), and are about 1 mm. in length. Spicules are present in the form of minute, slender, tuberculate spindles averaging ·1 mm. in length. These are arranged more or less longitudinally on the walls of the tentacles (fig. 2 *sp.*), and not *en chevron* as in many of the species. The *stomodaeum* is very long and much convoluted. The *mesenteries* are large, the ventral and lateral ones being provided with very stout and rounded mesenterial filaments, which in the preserved condition are much convoluted at the beginning of their course. I have been unable to find reproductive organs in the mesenteries of any of the specimens.

The **siphonozooids** are very well marked and extend for a considerable distance into the interior of the colony, but they are not so numerous as in *S. latum* and many other species. They are regularly arranged in rings round the autozooids, and are most numerous in the middle of the capitulum, where from four to five may be counted in a straight line between two autozooids. The average surface diameter of a siphonozooid is ·37 mm., and is greater than in *S. glaucum*. The stomodaeum may be seen in surface view as a key-hole shaped aperture. Its average length is ·32 mm., which is quite twice that of *S. glaucum*. The eight mesenteries are not so well marked as *S. latum*. The spicules have been fully described and figured by Marenzeller (1886). They are very abundant near the surface of the colony, but are relatively scarce in the coenenchym.

Zoochlorellae are present in this as in other species, but I have not been able to find any of the rounded cells with yellow contents which are present in *S. glaucum*, etc.

S. ehrenbergi, then, is characterised by:—(1) the form and distribution of the spicules which are numerous near the surface, but few in the coenenchym; (2) the tough, firm texture of the colony; (3) the large size of the autozooids, which have large, stout, rounded ventral and lateral mesenterial filaments; and (4) the clearly defined large siphonozooids, apparently less numerous than in other species, with a long stomodaeum fully twice the length of that of *S. glaucum*.

[1] A young mushroom-shaped colony of *Sclerophytum* may be easily distinguished from *Sarcophytum* or *Lobophytum* by the minute size or absence of siphonozooids. Where present, they can never be distinguished without the aid of a microscope.

2. *Sarcophytum glaucum* (Pl. XXVIII. figs. 3 and 4), 1833. Quoy et Gaimard (p. 270, Pl. XXII. figs. 11 and 12), 1886. Marenzeller (p. 352, Taf. IX. figs. 1 and 2).

A single well-preserved specimen was taken on the reef of Hulule, Male Atoll. Mr Gardiner observed this species to have large lobes much covered with mucus, with the polyps not generally completely contracted when living, even if exposed to low tide.

Specimens from different localities vary considerably in size. This specimen is 22 mm. high, the capitulum is 59 mm. × 45 mm. in diameter, and in the middle is 9 mm. in thickness. The margin is thrown into four large folds. In the middle of the disc the autozooids, which when expanded are about 2 mm. across the crown, are from 3—5 mm. apart, but on the margin are younger, smaller and only about 1 mm. apart. The siphonozooids are very regularly arranged between the autozooids, and are most numerous in the middle of the capitulum, where there may be from 6—13 siphonozooids in a straight line between two autozooids; on the margin there are only from 1—3 between two autozooids. The colour of the specimen in spirit is of a greenish stone colour, in the living condition the green colour is more intense. The specimen yields readily to the touch, but is fairly tough in texture. The stalk is short, thick and cylindrical, its surface is smooth and unwrinkled.

The species has so far been described from Australia, Red Sea, Tonga Island, Viti Island, and now Maldive Islands.

The **autozooids** are large, well-marked, and of a deep cream colour in spirit. Many of them are completely retracted. The average surface diameter of an autozooid cavity is 1—1·5 mm. The tentacles when expanded are long and slender with short simple pinnules in a single row down each side. Small spicules in the form of slender spindles are imbedded in the walls of the tentacles, and are so arranged that when an autozooid contracts the tentacles come together to form a cone, and the delicate fleshy parts are enclosed in and protected by a conical cap of spicules. The average diameter through the contracted crown of tentacles is 1·4 mm.

In the preserved condition the *stomodaeum* is much convoluted; the *siphonoglyph* is not readily seen, and, indeed, can only be distinguished in stained sections. The eight mesenteries are well-marked and provided with large mesenterial filaments, which are much convoluted at the beginning of their course. Each of the two dorsal mesenterial filaments has a groove running down the middle, lined by ciliated cells. The ventral and lateral mesenteries are rounded in cross section as in *Alcyonium*. I have observed no generative organs in this specimen, but in a specimen taken by Willey in Blanche Bay typical *Alcyonarian* ova measuring from ·05—·25 mm. in diameter were seen on the mesenteries.

The **siphonozooids** are rounded on their external surface, with the mouth sunk in a slight depression in the middle. Their surface diameter, which appears to be constant, is about ·2 mm., and they are usually arranged with the broad diameter of the stomodaeum in a definite direction. Their length varies according to age or to the proximity of an autozooid. When seen in longitudinal section a siphonozooid is conical in shape, the external surface being the base of a cone. The coelenteric cavity is prolonged at its apex into a longitudinal endodermal canal as in the species described by Moseley (1875, Pl. XIII. fig. 2). The stomodaeum is very short and broad in this form, the average length being ·16 mm., which is only half the length in certain other species (see table, p. 506). It is T-shaped in cross section, the siphonoglyph being well marked.

The *mesenteries* are not so pronounced as in *S. latum*. The two dorsal have grooved and ciliated filaments, while the ventral have a very short, free edge, but no filaments. The lateral appear to end with the stomodaeum, and consequently present no free edge. The coelenteric cavities of neighbouring autozooids and siphonozooids are placed in direct communication with one another by means of short ciliated canals.

In addition to the zoochlorellae which are present in considerable numbers, rounded cells of a yellow colour (fig. 4) occur in the ectodermal as well as endodermal tissues. The cells have a nucleus, and are filled with a granular yellow matter, which is insoluble in spirit and apparently unaffected by weak nitric or hydrochloric acids, borax-carmine, haematoxylin, oil of cloves or of cedar wood, but is stained black by iron-brazilien. These cells will be more fully described and figured in a later publication.

The **spicules** are most numerous near the surface of the capitulum, but they are not so densely packed as in *Alcyonium*. In this portion of the colony they have the form of tiny clubs with small heads, spindles, or spiny rods. The clubs are ·084—·224 mm. in length, and the rods and spindles about ·5 mm. by ·02—·04 mm. broad. Rods and spindles are numerous on the anthocodiae of the autozooids, and are arranged in regular oblique lines, so that when an autozooid is contracted, the soft parts are enclosed and protected by a conical cap of spicules (p. 509), which recalls the operculum of certain fossil corals.

The spicules of the coenenchym are slender spindles similar in form to those occurring in the autozooids. They are from ·56 mm. long and about ·018 mm. broad. Spicules ·07 mm. broad are also present; they are about the same length, and covered with simple spines. The spicules of the stalk are larger and stouter than those of the capitulum, being ·56—·7 mm. long and ·12 mm. broad. They are tuberculate, warted spindles, similar in form and sculpturing to those of the new genus *Sclerophytum* (fig. 20), but slightly smaller.

S. glaucum, then, is characterised by (1) its abundant mucous secretion, which gives to the colony in its living condition a slimy appearance; (2) its green colour, which however is somewhat soluble in spirit; (3) its soft, flexible texture; (4) the large size of the autozooids; and (5) the clearly defined siphonozooids, which differ from all other species which I have examined in the shortness of their stomodaea, and feebly marked mesenteries.

3. *Sarcophytum latum*, Dana, 1849 (Pl. LVIII. figs. 6 and 7), Dana, 1859, p. 125. Whitelegge, 1897, p. 215.

A single fragment of a colony was taken at Hulule, Male, Maldive Islands. It consists of a portion of the capitulum measuring 68 mm. × 42 mm. in diameter and about 10 mm. in thickness, and a portion of the stalk. As in Mr Gardiner's specimen from Funafuti the *autozooids* are usually about 1 mm. apart, and are much more numerous at the margin of the capitulum, where the autozooids are younger, and are consequently smaller than elsewhere.

The **siphonozooids** are fairly large, the average surface diameter of a siphonozooid being ·33 mm. There are usually from 3 to 4 in a straight line between two autozooids. The siphonozooids are often arranged with the ventral edges of the stomodaea pointing in the same direction, but here and there may be seen in alternating rows with the ventral edges pointing in opposite directions. The stomodaeum is longer than in *S. glaucum*, and is ·3 mm. in length. The eight mesenteries are all well-marked, the ventral and lateral mesenteries

have free edges, but no filaments; the former are a trifle longer than the latter. The dorsal mesenteries have grooved ciliated filaments. Ciliated transverse vessels between the zooids are very numerous. The *Internal Canal System* is well marked. Yellow cells are present as in *S. glaucum*.

The **autozooids** are fairly large with well-marked characters. The diameter through the crown of a completely retracted zooid is ·8—·9 mm., and of a fairly expanded zooid 1·2 mm. The diameter gradually diminishes posteriorly so that some distance below the surface it is sometimes difficult to distinguish between the cavity of an autozooid and that of a siphonozooid, except in sections. The anthocodia of expanded autozooids average 3 mm. The tentacles are short, pinnate, and blunt at the tip, averaging only ·56 mm. in length. The stomodaeum is long, with folded walls, and the siphonoglyph is not conspicuous. The eight mesenteries are extremely well marked, the muscle bands being clearly seen in sections. Ova are present on the mesenteries, measuring from ·03—·5 mm. in diameter.

This species is interesting because of its lobed capitulum (Dana, fig. 7), and its warted and zoned spicules (Whitelegge, Plate X. fig. 1). In both these respects it approaches the genus *Lobophytum*.

4. *Sarcophytum boettgeri.* Schenk, 1896 (p. 72, Taf. II. fig. 9, Taf. IV. figs. 29 and 30), var.

A single complete specimen was taken at the Suvadiva Atoll from a depth of 31 fathoms. It agrees in many respects with Schenk's description of the species from the Moluccas, but differs from his specimen in size. The stalk is longer and more slender, the capitulum has a smaller diameter, and is much thinner than in the type species. The colour is of a warmer brownish shade, and the autozooids are slightly larger.

The specimen is 50 mm. high. The stalk is 39 mm. long, 25 × 14 mm. broad at the base, and gradually diminishing in diameter to 9 × 7 mm.

The **autozooids** are about 2·5 mm. apart in the middle of the capitulum, but near the margin they are much more closely set. Many are expanded and measure about 1 mm. through the crown of tentacles. The **siphonozooids** are numerous, but so minute that they are invisible to the naked eye.

Owing to the presence of numerous large spicules near the surface of the capitulum and throughout the stalk the colony is fairly hard to the touch, and is only very slightly flexible. Near the base of the stalk there is a rhizome-like outgrowth which is attached at its distal end to a fragment of a shell. This probably gives additional support to the colony. A similar outgrowth is to be seen in a specimen of *Sclerophytum durum* (sp. nov. p. 528) from 24 fathoms, S. Nilandu. The colour in spirit is of a pale greyish-brown.

The **spicules** near the surface of the capitulum are very closely packed. They are of the tuberculate warted type found throughout the genus *Sclerophytum* (figs. 20 and 31). They vary in size, but the largest are about 1 mm. long by ·1 mm. in diameter. They are similar in form to those figured by Schenk, 1896 (fig. 28), but slightly larger. The spicules of the coenenchym and of the autozooids are long, slender rods and spindles, some of the latter with a few short spines. The largest of these spicules are about ·5 mm. long by ·04 mm. broad. I have observed this form of spicule in every species of *Sarcophytum* which I have examined (fig. 8). Most of the spicules of the stalk are like those near the surface of the capitulum, but among them may be seen a few slender spiny spindles like those of the coenenchym of the capitulum. They resemble those figured by Schenk (figs. 29 and 30).

5. *Sarcophytum roseum* (Pl. XXIX. figs. 10 and 11), sp. nov.

A single large fragment of a female colony consisting of a portion of the capitulum was taken at a depth of 25 fathoms to the west of South Nilandu Atoll. In spirit the specimen is of a beautiful brownish-pink colour, which was more vivid in the living condition. When taken it was associated with a red Chiton and a Lamellibranch. In the complete state the capitulum would be apparently cup-shaped.

The specimen yields slightly to the touch, and the surface is somewhat granular. The capitulum is apparently thickest in the middle, where it measures 11 mm. Towards the margin it thins out, so that a radial section through the capitulum is wedge-shaped. In all other specimens of the genus in the collection the margin of the capitulum is curved downwards and inwards to a more or less degree. In *S. latum* the fold or seam is very slight, but in this species it is entirely absent (fig. 11). The capitulum is irregularly lobed at the margin, and its under surface is wrinkled and granular. Through the ectodermal tissues marginal zooids may be seen running parallel with the surface.

Autozooids. On that portion of the capitulum which is farthest from the margin the autozooids are 7 to 10 mm. apart: near the margin they are much more numerous and are often less than ·5 mm. apart. Most of the autozooids are completely retracted, but here and there one may be seen with tentacles slightly expanded. Its colour is then seen to be of a deep rich pink showing up clearly against the pale pink background of the colony. The tentacles are short, simple and pinnate. The stomodaeum is convoluted in the preserved condition, and the mesenteries are well marked. Ova at various stages of development are present on the mesenteries, some of the largest being fully ·5 mm. in diameter.

The **siphonozooids** are clearly marked and can be easily seen without a lens: as in other species they are most numerous where the autozooids are fewest and *vice versâ*. Their average surface diameter is about ·45 mm. Their stomodaea are longer than in any other species which I have examined, and have an average length of ·4 mm.

The **spicules** are more numerous near the surface than elsewhere, in this position being in the form of small clubs and spindles averaging ·13 mm. in length and ·06 mm. in breadth (fig. 10, I, II, III). In the coenenchym they are slender, pointed spindles with proportionately large tuberculate warts, which have a tendency to be arranged in zones as in *S. latum* and in *Lobophytum*. The spindles measure ·2—·4 mm. long by ·06—·07 mm. broad, and a very few crosses ·3 × ·2 mm. are also present in the coenenchym. In shape the pointed spindles resemble those of *S. ehrenbergi*, but in that species the warts are smaller and have not a zonate arrangement. In this respect this species approaches *S. latum*, and the allied genus *Lobophytum*, but the spicules of *S. latum* are much broader in proportion to their length than those of this form.

6. *Sarcophytum tenuis* (Pl. XXVIII. fig. 6 and Pl. XXIX. fig. 9), sp. nov.

Two specimens, one with the lower portion of the stalk missing, and another more fragmentary, were taken well within the South Male lagoon at a depth of thirty fathoms. The colony is in the form of a stalked disc 63 × 58 mm. in diameter, and 4 mm. thick, excluding the anthocodiae of the autozooids. The portion of the stalk is 4 mm. long, and 15 × 5 mm. in diameter. The autozooids and siphonozooids are borne only on the upper surface and margin of the disc. The specimen is soft to the touch, but is of a tough texture, and of a dull brown colour.

Autozooids. The autozooids are most numerous round the margin, and most are almost completely expanded. In the middle of the disc they are from 5—10 mm. apart, but on the margin they are crowded together in radiating lines. The anthocodia, or free distal portion of an expanded autozooid, is 4—4·5 mm. in length with an average diameter of 1·3 mm. through the crown of tentacles. The tentacles are of the simple type (with a single row of pinnules on each side), and are about 1 mm. in length, so that they appear small compared with the large size of the anthocodia. The stomadaeum is long, and its walls are much folded. As in other species of *Sarcophytum* the siphonoglyph is not well marked. The mesenteries are very large, and are much convoluted in the preserved condition.

The **siphonozooids** are narrow and long, where their growth in length is not impeded by the proximity of autozooids. The surface diameter averages ·3 mm., so that they may be fairly easily seen with a lens. They apparently fill up all the spaces between the autozooids, and are consequently most numerous near the middle of the disc, where there may be as many as from 10—16 siphonozooids in a straight line between two autozooids. Nearer the margin there may be from 4—6, but the autozooids are so crowded on the margin that the intervening siphonozooids cannot be counted except in sections. The stomodaeum is short, but is slightly longer than that of *S. glaucum*; its average length is 2 mm. The mesenteries are apparently more conspicuous in this than in any other species which I have examined.

Spicules. This species is interesting because of its small, slender spicules, which are very few in number. It is very improbable that spicules have been dissolved out by an acid preservative because they are most numerous in the peripheral tissues, and in decalcified preparations the holes left by the spicules are small and few in number. As the specimens were taken in fairly deep water the sparsity of spicules may to a certain extent be due to their habitat.

The spicules are somewhat more numerous in the stalk than in the capitulum, but they appear to occur even there only near the surface, where they have the form of minute clubs ·17 mm. long and ·03 mm. broad. These spicules are similar to those near the surface of the capitulum. The spicules of the coenenchym throughout the specimens are very slender, pointed spindles, straight or slightly curved and dotted with a few minute spines (fig. 6); they are about ·5 mm. long by ·03 mm. broad. Long, slender clubs, about ·5 mm. in length, with small heads also occur. A few of the slender spindles are regularly arranged *en chevron* in the walls of the anthocodiae of the autozooids, while shorter spindles occur on the tentacles.

The species differs from all others which I have examined, in its soft, tough texture, in the sparseness and small size of its spicules, in its flattened disc-like form, and in the large size of its autozooids, which are extremely numerous on the margin of the disc. The siphonozooids appear to differ from those of other species in the length of their stomodaea (·2 mm.) and in their strongly marked mesenteries and filaments.

III. GENUS LOBOPHYTUM.

Lobophytum (amended genus)[1] (Pl. XXVIII. fig. 7, Pl. XXIX. figs. 12—14).

As in *Sarcophytum* and *Sclerophytum* a colony consists of two parts:—the capitulum and the stalk. The capitulum is the superior portion of the colony, and bears the anthocodiae; on its surface are the apertures of the zooids. The capitulum is supported by the stalk, by means of which the colony is attached to the substratum. The stalk has no zooid apertures of any description on its surface, but is penetrated to the base of the colony by the cavities of the primary autozooids.

As in *Sarcophytum*, all the species are dimorphic, autozooids and siphonozooids being both well marked. Young colonies are often mushroom-shaped (fig. 12), the capitulum representing the pileus of the mushroom. As the colony grows older irregular excrescences appear on apparently any portion of the surface of the capitulum. These often attain a considerable size, so that the original resemblance to a mushroom is entirely lost, and the capitulum has an irregularly-lobed appearance (fig. 7). Calcareous spicules, imbedded in the mesogloeal and often ectodermal tissues, are to be found throughout the colony. They are usually very small, short and stout, or long and slender, and generally studded with large warts, arranged in zones[2]. Throughout the genus they are apparently similar to those figured by Marenzeller (1886) in his original description. When clubs are present they are few in number, and are not crowded near the surface as in the new genus *Sclerophytum*, in *Acrophytum* and in *Alcyonium*.

The **autozooids** are very well-marked, and are similar in form and general structure to those of *Sarcophytum*, but much larger than *Sclerophytum* (figs. 2, 13, 22). The eight tentacles are slightly longer and more slender than in any species of *Sarcophytum* which I have examined. They are of the simple pinnate type with a single row of pinnules down each side, the pinnules apparently less numerous in the younger than in the older autozooids.

The *stomodaeum* is very well-marked, but the siphonoglyph is not easy to distinguish in the preserved state except in stained sections. All the mesenteries have mesenterial filaments. The two dorsal filaments are similar in form to those of *Alcyonium*, and to those of the siphonozooids, in that they are ciliated and grooved. The ventral and lateral mesenterial filaments are usually rounded in cross section, but here and there may be seen a filament which is slightly grooved down the middle. The ova are similar in size and shape to those of other Alcyonaria. I have been unable to find male cells in any of the specimens.

The **siphonozooids** are very similar in form and function to those of *Sarcophytum*. They have no tentacles, and only the two dorsal mesenteries bear mesenterial filaments. These zooids have no special digestive cells, and do not bear reproductive organs. They appear to be respiratory and excretory in function.

The **canal system** is well developed and is similar in general structure to that of *Sarcophytum*. It differs from *Sclerophytum* in the absence of a special superficial canal system, which is so well marked in that genus. As in *Sarcophytum* transverse ciliated

[1] A detailed account of the general and minute anatomy of this genus will be published later.

[2] The zoned character of the spicules is not confined to this genus, for similar spicules are present in *Sarcophytum latum*.

channels connect the coelenteric cavities of the zooids (fig. 3), which, by enabling the circulation of sea-water through every zooid, effectively aerate the internal parts of the colony.

7. *Lobophytum pauciflorum.* Marenzeller (Pl. XXVIII. fig. 7 and Pl. XXIX. figs. 12—14).

Two fragments of a large colony were taken in shallow water on the Hulule, Male, reef. Two young complete colonies, which had retained to some extent their mushroom-shape (fig. 12), were also dredged, one from 20 fathoms, Mahlos Atoll, and the other from 24 fathoms in the S.-E. passage of Kolumadulu Atoll.

This appears to be the most common as well as the most widely distributed species of the genus. It was first taken in the Red Sea and subsequently described by Ehrenberg (1834). It has since been recorded by many other writers: 1848, Dana, *Alcyonium pauciflorum*; 1877, Klunzinger, *Sarcophytum pauciflora*; 1886, Marenzeller, *Lobophytum pauciflorum.* Also var. *validum*; 1897, Whitelegge, var. *validum*; 1900, Hickson and Hiles, *Lobophytum pauciflorum.* In distribution it is now known from the Red Sea, New Zealand, Andamans, Tonga, Moluccas, Funafuti, New Britain, and now Maldive Islands.

The **spicules** have been described by Klunzinger and by Marenzeller. As in all other species of the genus they are extremely small, elliptical, or cask-shaped, usually three times as long as broad, but some longer and some shorter. Tuberculated warts are usually arranged in zones on their surfaces, but here and there a spicule may be seen without warts. Spicules of the coenenchym are ·16—·24 mm. in length, and are ·064—·08 mm. broad. Those near the surface are similar in form, but smaller, with only two rows of warts; they are ·08—·128 mm. long and ·032 mm. broad.

In all the specimens most of the **autozooids** are contracted, and in many cases are withdrawn to a considerable distance below the surface of the colony. Owing to the different degrees of contraction of individual autozooids in the preserved state their dimensions vary considerably. The average diameter of a fairly expanded autozooid through the crown is 1·8 mm., and through the base of the tentacles 1·4 mm. New autozooids are budded off from the endodermal canals near the surface at any portion of the capitulum, this giving to the colony its lobed form. As in *Sarcophytum* siphonozooids are formed also by budding from the endodermal canals, chiefly in the vicinity of the autozooids, except on the margin, where the siphonozooids are very numerous, and the autozooids very few.

The **tentacles** are fairly long and conical (fig. 13, *tent.*), their average length when fairly expanded being ·8 mm. They are of a simple pinnate character, each having down either side a single row of pinnules, averaging in a fairly expanded tentacle ·13 mm. in length. The pinnules are less numerous in the young than in the older zooids. In a mature autozooid the pinnules of a single tentacle are almost uniform in size, but in young autozooids they are largest at the tip, and gradually become smaller towards the base of a tentacle. The number of pinnules on the tentacle does not appear to be a constant feature, sometimes a tentacle has more pinnules on one side than on the other, but in such cases the autozooids may not be mature.

The **siphonozooids** (figs. 13 and 14, *si.*) are universally scattered in more or less straight lines between the autozooids over the whole of the upper surface of the capitulum. They are about ·3 mm. in surface diameter, and can therefore be seen with the unassisted eye. On the tips of the lobes there may be from two to five siphonozooids in a straight line between two autozooids, but on the sides sometimes as many as 10 to 15. On the extreme

margin of the capitulum the siphonozooids are extremely numerous, a contrast to *Sarcophytum*, in which the autozooids are most numerous in this position. The stomodaeum (fig. 14, *s.*) is short and straight, averaging ·26 mm. in length. The siphonoglyph is well marked.

As a rule, the length of a siphonozooid varies according to age, the young siphonozooids are extremely short, but the older ones may extend for quite a considerable distance into the interior of the colony. The diameter of a siphonozooid is greatest at the surface, and gradually decreases inwardly. Some distance below the surface the cavity is sometimes so narrow that, but for the presence of the dorsal mesentery filaments, it might be easily mistaken for an endodermal canal. Sooner or later a siphonozooid terminates posteriorly in the endodermal canal, from which as a bud it originated. The keyhole shaped mouth aperture of the stomodaeum, with well-marked ciliated siphonoglyph, and the eight mesenteries of a siphonozooid, may be easily distinguished in surface view (fig. 13).

IV. GENUS SCLEROPHYTUM.

Sclerophytum, gen. nov. (Pl. XXVIII. fig. 8, Pl. XXIX. figs. 15—18, Pls. XXX. and XXXI.).

In the Introduction to this paper (pp. 504—5) I have given the most important reasons for the establishment of this genus, and for the inclusion in it of the following species, which have hitherto been attributed to the genus *Lobophytum*: *L. densum* = *Sclerophytum densum*; *L. densum*, var. = *Sclerophytum*, sp. nov.[1]; *L. confertum* = *Sclerophytum confertum*[1]; *L. marenzelleri* = *Sclerophytum marenzelleri*[1]; *L. tuberculosum* = *Sclerophytum tuberculosum*[1]. In addition to these six new species were collected by Mr Gardiner on the Maldive reefs.

The genus *Sinularia* (W. May, 1899, p. 100), which is founded entirely upon the form of the colony and the character of the spicules, cannot be maintained. Further investigation of its single species *S. brassica* will doubtless result in its inclusion in the present genus.

Brief Diagnosis of Genus. Colony lobed and sometimes similar in form to *Lobophytum*. Corallum often hard and granular (exceptions given in table, p. 531). Colonies usually dimorphic, but the siphonozooids are very minute and exhibit unmistakable signs of degeneration. Autozooids are usually smaller than in *Sarcophytum*, *Lobophytum* and *Alcyonium*, and in some cases slightly degenerate. There are two well-marked canal systems, (i) superficial, and (ii) internal. The superficial canals in most species large and numerous, but this system absent or only feebly marked in *Lobophytum*, *Sarcophytum* and *Alcyonium*. The internal canal system is similar in many respects to that of *Sarcophytum* and *Lobophytum*, and penetrates down to base of colony. In *Alcyonium* the internal canal system is not well marked in the deeper portions of the colony.

Spicules—usually distinct from those of *Sarcophytum* or *Lobophytum*; they are generally large and of varied form. Tuberculate spicules occur throughout the genus. Minute clubs and spindles are crowded near the surface, and form a very much thinner crust than in *Alcyonium* or *Acrophytum*.

Great diversity of form is to be found among the representatives of the genus in the collection. The young colonies are more or less mushroom-shaped (fig. 18). Some specimens have a cup-shaped capitulum with marginal lappets—these are usually fairly young colonies

[1] These species are not present in the collection.

(fig. 30). Owing to the growth of new lobes, in older specimens the cuplike form is often obliterated (fig. 29). Many exhibit a more or less well-marked lateral compression. Some of the specimens have a short, broad stalk and a much lobed convex capitulum as in *Sc. capitale* (fig. 8), in which the branches are closely set. In some cases the lobes are long, slender, branched, and digitate as in *Sc. polydactylum*. Some specimens are long-stalked and erect with slender or stout, more or less arborescent branches as in *Sc. querciforme* and *Sc. palmatum* (figs. 33 and 26).

The **mesogloea** in which the spicules are imbedded varies in density in different species. It is most abundant in the soft fleshy forms. In species with very large spicules it is always very dense and stains readily.

The **spicules** are large compared with those of allied genera. Spicules 2—4 mm. in length, are common in many species, but in *Sc. querciforme* they attain a length of 6 mm. and in *Sc. durum* are even larger, a fair number attaining 7 mm. in length by 1·7 mm. in breadth.

Most of the spicules have tuberculate warts on their surface (fig. 20) and vary considerably in shape. The most common type is the spindle with blunt or sharply-pointed ends. This form is found throughout, but is not confined to the genus, it occurs also in *Sarcophytum* (*S. plicatum* and *S. boettgeri*), and also in *Sinularia*, which, however, cannot be regarded as a true genus (p. 516). I have not observed this form of spicule in any species of the amended *Lobophytum*.

Some of the tuberculate spicules are curved, some are crescentic, kidney-shaped, or ridged so that they are triangular in cross section, as in *Sc. durum* (fig. 31). In many species they are branched and are Y or K shaped, or have several forks as in *Sc. capitale* (fig. 16). They are sometimes irregularly dumb-bell shaped (fig. 32 *f*), but this form of spicule is rare. The tubercles are often arranged in more or less straight lines. Usually they are very numerous but in a few cases are sparsely scattered over the surface of a spicule. In *Sc. durum* and other species the tubercles are so closely set that a mosaic is formed (fig. 31 *b*).

In every species of the genus, which I have examined, minute clubs and spindles are more or less crowded near the surface, but they form a much thinner crust than in *Alcyonium* or *Acrophytum*. These clubs often vary in shape to a considerable extent in a single specimen (fig. 32 *a, b, c, d, e*). In some cases, the head is simply a knotted prolongation of the handle, but many of the clubs are bi- or tri-ramous. In all cases tuberculate warts are scattered in varying numbers over their surface. The spindles near the surface are usually very small, and dotted with a few simple spines (fig. 32 *g*). Small spindles or rods generally occur in the outer walls and tentacles of the autozooids, and form a protective, calcareous, more or less conical cap which covers the aperture when the autozooid is partially retracted as in *Sarcophytum*.

Zooids. Of the eight species represented in the collection, four are dimorphic, but in all these the siphonozooids show unmistakable signs of degeneration. In two species the latter has proceeded further, and only vestiges of siphonozooids are present. In the remaining two species siphonozooids are absent.

In some of the species slight signs of degeneration are discernible in the autozooids.

The **autozooids** on the whole are smaller in this genus than they are in either *Sarcophytum* or *Lobophytum*. They are usually most numerous on the tips of the lobes.

Throughout the genus the *tentacles* are short, blunt, and stumpy, compared with other genera. They vary slightly in size in different species (Table, p. 531) and in some cases are extremely small. They are only slightly pinnate, and in *Sc. gardineri* the pinnules are extremely rudimentary. Owing to the contracted condition of many of the specimens it was found impossible to determine the actual length and pinnate character of the tentacles of some of the species. In *Sc. capitale* and *Sc. palmatum*, which have comparatively large tentacles, some of the autozooids are expanded. In both of these species a double row of very small pinnules was seen on each side of the tentacles (figs. 17 and 27); in this respect this species approaches the genus *Xenia*.

The *stomodaeum* is comparatively long and has a well-marked *siphonoglyph* in every species of the genus. The *mesenteries* differ in size, in *Sc. palmatum*, *Sc. hirtum*, and *Sc. capitale* being well marked, in *Sc. densum*, *Sc. polydactylum*, *Sc. durum* and *Sc. querciforme* long and slender, but in *Sc. gardineri* only the dorsal ones well marked. The dorsal mesenterial filaments are long, broad, grooved and ciliated in every species, but the ventral and lateral vary in size in different species. These filaments are often very short and feebly developed and are never long or well marked (Table, p. 531); in *Sc. gardineri* they are apparently absent. The small size or entire absence of ventral or lateral mesenterial filaments is probably correlated with the presence of numerous zoochlorellae, for they are most numerous in *Sc. gardineri*, which has no ventral or lateral filaments.

Reproductive cells are not present in all the specimens, and where they do occur they consist entirely of female cells. I have not been successful in obtaining a single specimen with male cells. The ova appear to be of the typical Alcyonarian type, but the occurrence of ova on the dorsal mesenteries of *Sc. gardineri* is interesting (pp. 527—8).

Siphonozooids are present and are numerous in many but not in all species of the genus. They are very small compared with those of *Sarcophytum* and *Lobophytum* and show unmistakable signs of degeneration. They are largest in *Sc. capitale* where they have an average length of ·3 mm. (figs. 17 and 19, *si.*), but they are not difficult to recognise in stained preparations or sections of *Sc. densum*, *Sc. hirtum*, and *Sc. palmatum*, in which they vary from ·1 mm.—·17 mm. in length. In all these species they have small stomodaea which usually open to the exterior (figs. 19, 21, 22, 25, *m. ap.*), but this is often difficult to see except in stained sections. Traces of mesenteries occur in many of the siphonozooids. As a rule a siphonozooid terminates posteriorly in a large transverse vessel of the superficial canal system.

In *Sc. durum* and *Sc. polydactylum* the degeneration of the siphonozooids has proceeded much further than in *Sc. capitale*, *Sc. densum*, *Sc. hirtum*, and *Sc. palmatum*. In these two species the siphonozooids are represented by very short vertical caeca from the superficial, transverse canals. Traces of a stomodaeum may often be seen in an aggregation of ectoderm cells between the terminal portion of the caeca and the surface of the colony, but I have not observed any apertures to the exterior, nor any traces of mesenteries. *Sc. gardineri* and *Sc. querciforme* are similar anatomically in many respects to other species of this genus, but are more degenerate in character, and have completely lost their siphonozooids. In *Sc. gardineri* the autozooids also exhibit slight signs of degeneration.

Canal-systems and formation of zooids by budding. The transverse superficial and the internal canal systems can be easily distinguished in decalcified moderately thin free-hand sections, mounted simply in glycerine jelly or stained with borax carmine or

brazilin, but the superficial canal system is best observed in stained microtome sections about 20 μ in thickness. These sections however are too thick for histological purposes. *The transverse superficial canal system* is extremely well-marked in most species. The principal vessels are comparatively broad channels, which run also immediately below but parallel with the surface (fig. 22 *t.s.c.*); these I have named the "transverse canals." The vessels of this system ramify and anastomose throughout the peripheral tissues, they communicate with the terminal portions of vessels of the internal system, and have numerous apertures into the coelenteric cavities of neighbouring autozooids (fig. 22 *ap.c.*). From these vessels buds arise towards the surface, which in *Sc. gardineri* and *Sc. querciforme* develop into autozooids. In all the other species in the collection buds are extremely numerous and are very regularly arranged near the capitular surface, and differ from autozooid buds (1) in that they are all arrested at a very early stage, which appears to be constant for the species, and (2) differ also to a certain extent in development. There can be no doubt that these buds are homologous to the siphonozooids of *Sarcophytum* and *Lobophytum*, from which they differ in that their growth and development are arrested at a much earlier stage. These rudimentary siphonozooids retain throughout life their intimate connection posteriorly with the transverse vessels from which they originated (fig. 22). In *Sc. capitale*, *Sc. densum*, *Sc. palmatum*, and *Sc. hirtum* development is not arrested until the rudiments of a stomodaeum with mouth aperture and rudiments of mesenteries have been formed. In *Sc. durum* and *Sc. polydactylum* development is arrested at an earlier stage, a few ectoderm cells representing the stomodaeum wander into the mesogloea about the terminal portion of a bud, but there is no mouth aperture, and the bud is simply a caecum from a transverse canal, with only traces of mesenteries. In dimorphic species the number of siphonozooids arising from a transverse canal varies, but in *Sc. capitale* seven or eight siphonozooids terminating in a single vessel may often be counted between two autozooids.

In the presence of a special superficial canal system this genus is completely separated from *Lobophytum*, *Sarcophytum*, and *Alcyonium*, but in this respect it approaches *Xenia*. *Zoochlorellae* are numerous in the endoderm of the superficial canals, and are present in varying numbers in the lumen of the canals.

The *internal canal system* is strongly marked and is very similar to that of *Xenia*. It differs from that of *Sarcophytum* and *Lobophytum* in that the siphonozooids do not terminate posteriorly in the longitudinal vessels of the system, but in the transverse vessels (fig. 19). The principal vessels run more or less parallel with the longitudinal direction of the autozooids and have numerous apertures into their coelenteric cavities (fig. 22 *ap. c.*). They ramify and anastomose throughout the internal and especially in the basal portions of the colony. Many vessels terminate near the periphery in the vessels of the superficial canal system. *Zoochlorellae* are only to be found in this system in those canals which lie near the surface.

Zoochlorellae are present in all the specimens of the genus in the collection, but they vary in number in different species. Their numbers, however, do not appear to be affected by bathymetric variations within certain limits, for they are fairly numerous in specimens which have been taken at a depth of from 24—34 fathoms (Table I. p. 531). They are most plentiful in *Sc. gardineri* and least in *Sc. capitale*, both of which species were taken only in shallow water.

I have suggested (p. 528) that their presence in enormous numbers in *Sc. gardineri* is

correlated with the reduced size of the tentacles and the absence of ventral and lateral mesenterial filaments.

8. *Sclerophytum capitale* sp. nov. (Pl. XXVIII. fig. 8, Pl. XXIX. figs. 15—17).

Two specimens were obtained from the reef at Hulule, Male Atoll, from shallow water. One specimen is complete (fig. 8), the other has a portion of the stalk and capitulum missing. The complete specimen is attached basally to a fragment of hard coral.

The colony is fairly large, broad and laterally compressed, with a beautifully lobed convex capitulum. The lobes are numerous, many of them are laterally compressed; some are branched. The colony is 65 mm. high, and 70 × 35 mm. broad. The stalk is irregular in outline at the base, but the sides are rounded unbroken, and granular to the touch. The height of the stalk is 27 mm. and the breadth is 43 × 29 mm. The colour of both specimens in spirit is yellowish-grey.

Spicules. Clubs and slender spindles are crowded near the surface as in other species of *Sclerophytum*. Most of the clubs have small knotted heads (fig. 15) and are about ·18 mm. in length. A few clubs occur, which are bi- or tri-ramous; they are slightly longer and more slender than those of *Sc. densum*. The tuberculate spicules (fig. 16) are smaller and less numerous than in many species of the genus. In the capitulum they are 1—2·5 mm. in length, but they are a little larger in the stalk, where some of them attain a length of 3 mm. These spicules vary considerably in shape as well as size (fig. 16); regularly and irregularly curved spindles are numerous. Crescentic, Y and K-shaped spicules also occur, as well as a few spicules irregularly forked at both ends.

The **autozooids** are larger in this than in many species (Table I. p. 531), an expanded zooid measuring about 1 mm. across the crown. They are very regularly distributed over the surface of the capitulum, but they are slightly more numerous on the tips of the lobes, where growth is apparently most vigorous. In vertical sections they appear to be very long and slender, broadest at the surface and tapering gradually posteriorly.

The *tentacles* are apparently longer than in any species except *Sc. palmatum*, when fully expanded measuring about ·45 mm. in length by ·2 mm. in breadth. They are broadest at the tip and are not bluntly conical in the preserved condition as in other species. The tentacles like those of *Sc. palmatum* are interesting because they have a double row of pinnules down each side (fig. 17 *tent.*), in this respect approaching the genus *Xenia*.

The *stomodaeum* is long and convoluted, and the *mesenteries* are all well-marked. All have mesenterial filaments. The dorsal ones are similar to those of other species. The ventral and lateral mesenterial filaments are short but are clearly marked. A partially digested mass of food material containing a few zoochlorellae in the process of disintegration was observed in the coelenteric cavity of one of the autozooids.

Siphonozooids are present in this species (figs. 17 and 19, *si.*), but they are rudimentary. They are, however, larger in this than in any other species of the genus which I have examined. Many of them have an extremely small stomodaeum, which in sections is seen to open to the exterior. They terminate posteriorly in the transverse vessels of the superficial canal system. Zoochlorellae occur in the endoderm and the superficial canal system, but they are not numerous in the coelentera nor in the lumen of the canals.

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Canal Systems. The superficial and internal canal systems are both extremely well-marked. Near the surface the vessels are very large (fig. 17) compared with those of other species. They are much branched and form an intricate network. The large transverse vessels run immediately below the siphonozooids and their lumen is continuous with their coelenteric cavities (fig. 19). They also communicate with the vessels of the internal canal system and directly or otherwise with the coelenteric cavities of neighbouring autozooids. The breadth of the transverse vessels is ·07—3 mm.

The species is characterised by (1) the tough fleshy texture of the colony; (2) the small size of the tuberculate spicules; (3) the siphonozooids less degenerate than in other species; (4) the superficial and internal canal systems extremely well-marked; (5) zoochlorellae less numerous than in any other species in the collection.

9. *Sclerophytum densum* (= *Lobophytum densum* Whitelegge, 1897, p. 219, figs. 19—22), Pl. XXIX. fig. 18, Pl. XXX. figs. 20—22.

One complete specimen over the edge of a shoal from Addu Atoll, at a depth of 11 fathoms. Several fragmentary specimens from shallow water from the western reef of Hulule, Male Atoll. Two fragments from 25 fathoms, Miladumadulu Atoll. One complete young specimen (fig. 18) from 34 fathoms, Felidu Atoll (this specimen has not yet lost its mushroom-like form although lobes have grown out from the margin).

The specimens vary considerably in shape and size, are all hard and brittle, and their surfaces rough to the touch. The capitula of mature specimens have numerous lobes, which vary in size in specimens from different localities. In many cases the margin of the capitulum has no seam, so that but for the presence of zooid apertures on its surface, the capitulum passes almost imperceptibly into the stalk.

I have compared these specimens with others from Funafuti, China Seas, and British New Guinea and find them to agree fairly well in all essential particulars. The species is the commonest in the collection and appears to be the most widely distributed of the genus. Its bathymetric range from shallow to fairly deep water is very interesting. The colour in spirit varies in individual specimens, some are dark brown, some are dark yellow, while others are greyish-brown in colour. The spirit in which the specimens had been preserved had a distinct greenish tinge, which may be due to the solution of green colouring matter in the zoochlorellae, as they are very numerous in the canals and endodermal tissues near the surface of the colony.

The **spicules** of this species are described and figured by Whitelegge. As they do not differ in any important respect from those of other species, they may be regarded as being fairly typical of the genus (fig. 20) if we except *Sc. durum* which apparently has no branched tuberculate spicules. Minute clubs and spindles are crowded near the surface. The most common tuberculate spicules are 2—3 mm. in length.

The mesogloea is of a dense tough nature, stains very readily, and is of a yellowish-brown colour in spirit specimens.

The **autozooids** are very numerous, regularly arranged on the lobes, and apparently just as abundant in the furrows between the lobes. The diameter of an autozooid cavity (fig. 22) is greatest just below the surface and averages ·75 mm., in the stalk being slightly reduced.

The tentacles (fig. 22 *tent.*) are very small but are slightly larger than those of *Sc. durum*, being about ·4 mm. long and bluntly conical. They are pinnate, but I have been unable to see more than a single row of pinnules down each side.

The *stomodaeum* (fig. 22 *s.*) is long, and somewhat convoluted and is ·6—·85 mm. in length. The siphonoglyph is clearly shown in transverse sections.

The *mesenteries* are long and slender (fig. 22); the ventral and lateral mesenterial filaments are short and broad and measure about ·18 mm. in length (fig. 22 *v. m. f.*, *l. m. f.*). The dorsal mesenteries are much longer and are broader than the others, have broad grooved ciliated filaments (fig. 22) and are similar to those of other Alcyonaria.

Ova in all stages of development are present in the mesenteries of one of the fragmentary specimens from shallow water. They are of the typical Alcyonarian character and are of a yellowish-brown colour. The largest are easily seen with the naked eye.

Siphonozooids. Whitelegge (1897, p. 220) says of this species, "The Siphonozooids are minute and the orifices difficult to distinguish even with a lens."

If a thin strip of tissue be taken from the surface of the colony and examined under the microscope the siphonozooids are seen to occupy minute rounded areas surrounded by a spicular tissue containing minute clubs and spindles, as in *Sc. capitale* (fig. 17). It is only after decalcification and staining (borax-carmine answers very well) that the stomodaea and their apertures can be distinguished (fig. 21). The aperture is often rounded, but it is occasionally keyhole-shaped[1]. As in other dimorphic species the siphonozooids terminate posteriorly in the transverse vessels of the superficial canal system (fig. 22). As these vessels lie very near the surface of the colony the siphonozooids are necessarily very short, averaging ·17 mm. long.

The stomodaeum is usually a tiny tube one cell in thickness and one or two cells in length. Sometimes it is a solid cord of cells without lumen so that the siphonozooids have no aperture to the exterior. Traces of mesenteries are not difficult to perceive in some of the siphonozooids.

Canal Systems. Both superficial and internal canal systems are clearly marked (fig. 22), and may be regarded as being typical of the genus (pp. 518–19). The vessels ramify and anastomose in all directions, so that a complete circulation of fluids is ensured throughout the colony. The vessels near the surface are crowded with zoochlorellae. The transverse vessels lie very near the surface, they are not so broad as the transverse vessels of *Sc. capitale*, their average diameter being ·08 mm.

10. *Sclerophytum hirtum* sp. nov. (Pl. XXX. figs. 23—25).

A single well-preserved specimen from Naifaro reef, Fadifolu Atoll, having a portion of the stalk with basal attachment missing (fig. 23), 46 mm. high and 66 × 35 mm. broad.

The stalk is short, broad, laterally compressed, and is much wrinkled vertically, its surface is granular and it yields slightly to pressure. Its height (incomplete) is 22 mm. and breadth 45 × 25 mm. The capitulum is irregularly divided into numerous and slightly flexible lobes. The primary lobes or branches vary to a considerable extent in height, breadth, and number of secondary lobes. The mode of branching is irregular; di- or tri-chotomy is frequent, but here and there lateral branches are given off from a common stem, some of these branches

[1] These apertures should not be confused with the lobes left by spicules after decalcification.

ramify dichotomously. The primary branches are 10—22 mm. high and 10—17 × 7—8 mm. broad. In spirit the specimen is of a dull brownish-grey colour. The specimen is firmer in consistency and less fleshy than *Sc. capitale*, but not so hard and brittle as *Sc. densum*, *Sc. durum*, *Sc. querciforme*, etc.

The **spicules** are very numerous, clubs are closely packed near the surface, and most of the tuberculate spicules are very densely set with warts (fig. 24). The clubs have slender handles, but vary considerably in shape and size. They may have from one to four tuberculate heads. They are ·1—·33 mm. in length and ·02—·12 mm. in diameter through the head. Very slender clubs and spindles are present in the tentacles. In a partially retracted condition of the autozooid, they form an outer protecting conical wall to the soft fleshy tissues of the autozooid. The tuberculate spicules show great diversity in form and size (fig. 24 *a*, *b*, *c*, *d*), they are 1·1—4 mm. in length and ·18—1 mm. in breadth. Forked, curved, and branched spicules are present similar to those of *Sc. capitale* (fig. 16). Irregular spindles constricted in the middle (fig. 24 *d*) also occur, but they are not common. Some of the spindles have few warts with very small tubercles, so that they seem to be beset with small spines.

The **autozooids** are very regularly arranged over the whole of the capitular surface, and are 1—1·5 mm. apart. Many of them are expanded, measuring about ·8 mm. across the crown. The *tentacles* are short, broad, and bluntly conical, there are indications of a double row of small pinnules down each side. Spicules in the form of slender clubs and spindles are regularly arranged on the outer walls. The *stomodaeum* is long and convoluted, and the siphonoglyph is strongly marked. The *mesenteries* are larger and stouter structures than in many species of the genus. The ventral and lateral mesenterial filaments are longer and broader than in *Sc. densum* and *Sc. durum*. The dorsal mesenterial filaments are similar to those of other species. Reproductive cells were not observed in the specimen.

Siphonozooids (fig. 25). The siphonozooids are very rudimentary, and are so minute that they cannot be distinguished without the aid of a microscope. Their average length is ·1 mm. and breadth ·045 mm. If a thin strip of tissue be carefully removed from the surface of the colony and stained with borax-carmine, the siphonozooids are seen to occupy more or less hexagonal or rounded areas, and are separated from each other by a spicular tissue containing minute clubs and slender spindles as in *Sc. capitale* (fig. 17). The siphonozooids appear to be devoid of spicules, but with high powers there may be seen a few extremely minute ones imbedded in the ectoderm cells. The rudimentary stomodaeum with its aperture to the exterior (fig. 25) is seen in surface view to be keyhole-shaped, in a few cases rounded, but sometimes the aperture cannot be distinguished even in sections. Traces of mesenteries are to be found in some of the siphonozooids.

Canal Systems. As in other species, the transverse superficial canal system is well-marked, the average diameter of the large transverse vessels being ·07 mm. If allowance be made for the great amount of space taken up by the numerous tuberculate spicules the internal canal system may also be said to be well-marked. The average diameter of the longitudinal canals near the surface is ·04 mm. near the base of the colony, the canals are broader and have an average diameter of ·07 mm.

Zoochlorellae are numerous in that portion of the endoderm of the canals which lies nearest to the surface of the colony. They are not numerous in the lumen of the canals.

The species approaches *Sc. capitale* and *Sc. densum* in that the siphonozooids are less degenerate than in the other species of the genus which I have examined. They are smaller than those of *Sc. capitale*, but agree with that species in having indications of a double row of pinnules on the tentacles and in that the mesenteries and mesenterial filaments are fairly well-marked, and are longer and broader than those of *Sc. densum*.

11. *Sclerophytum polydactylum* (= *Alcyonium polydactylum* Dana, = *Lobularia polydactylum* Ehrenberg).

A single complete and excellently preserved specimen, attached basally to a piece of hard coral, was taken at 25 fathoms, Miladumadulu Atoll. The colony has a marked lateral compression and is 48 mm. high. The capitulum is 80 × 34 mm. broad. The base of the stalk is irregular in outline, the greatest height of the stalk is 26 mm., its breadth is 58 × 31 mm. The specimen is of a tough fleshy consistency yielding slightly to pressure. The lobes are long and slender compared with other species, and are slightly flexible. The colour in spirit is a pale brownish-grey.

The appearance of the colony is very similar to the specimen figured by Klunzinger, 1879 (p. 26, Taf. 1, fig. 6) with which it also agrees in the form and character of the spicules. For many years the species has been included in the genus *Alcyonium*. A study of its anatomy however reveals its generic identity with the newly established genus *Sclerophytum*.

The **spicules** are described and figured by Klunzinger, many of them are of the tuberculated warted type. The spindles average 2 mm. in length and ·45 mm. in breadth. Crosses, K and Y-shaped spicules, and a few spiny spindles occur. Clubs are closely packed near the surface as in other species.

There are no true **siphonozooids** in the species.

The **autozooids** are very numerous and are regularly arranged on the many lobes. In the furrows between the lobes they are less numerous. The autozooids are very small, their cavities averaging ·5 mm. in diameter near the surface. When partially retracted, they are conical in surface view, the tentacles bending over towards the middle. Regularly arranged minute spicules in the form of slender spindles are imbedded in their outer walls, forming conical shields which effectively protect the soft delicate tissues within. Young autozooids arising from endodermal canals are numerous on the tips of the lobes. The tentacles are pinnate but they are all more or less retracted so that it is impossible to count the rows of pinnules.

The *stomodaeum* and *siphonoglyph* are similar to those of other species. The *mesenteries* are all long and slender, but the dorsal ones are the most prominent. The ventral and lateral mesenteries have short, feebly-marked mesenterial filaments, but the dorsal mesenterial filaments are broad, grooved, and of considerable length. I have been unable to find male or female cells in the specimen.

Canal Systems. The transverse superficial canal system is extremely well-marked. Short, broad, vertical caeca are given off from the large vessels of this system towards the surface, but do not communicate directly with the exterior. There can be no doubt that these caeca are identical in origin and to a certain extent in structure with the degenerate siphonozooids of *Sc. capitale*, *densum*, *hirtum*, and *palmatum*, but in this species degeneration has proceeded so far that the siphonozooids have no stomodaeal apertures. Traces of stomodaea

may, however, in many cases be seen as aggregations of ectoderm cells about the upper terminal portions of the caeca. The average diameter of the transverse vessels is ·16 mm.

The internal canal system does not differ in any important respect from that of other species. The vessels of this system gradually become larger as they approach the surface. Many of the longitudinal vessels terminate in the superficial canals.

Zoochlorellae are present in considerable numbers in the endoderm and lumen of the superficial canals, but they are not so numerous as in *Sc. gardineri.*

This species is interesting because in many respects it forms an important link between *Sc. capitale, densum, hirtum,* and *palmatum,* which have clearly marked but degenerate siphonozooids, and *Sc. gardineri* which has no siphonozooids. In *Sc. polydactylum* the autozooids are small and appear to be slightly degenerate in the small size of the tentacles, and in the feebly-marked ventral and lateral mesenterial filaments. There are no siphonozooids which are functional as such, but traces of these individuals remain as the vertical caeca from the transverse vessels of the superficial canal system. Zoochlorellae are abundant in the endoderm and lumen of the superficial canals, and to a certain extent in the endodermal tissues of the zooids, but they are not nearly so numerous as in the more degenerate *Sc. gardineri.*

12. *Sclerophytum palmatum* sp. nov. (Pl. XXX. fig. 26 and Pl. XXXI. fig. 27).

A single well-preserved specimen was taken in shallow water from Hulule, Male Atoll (fig. 26).

The colony is erect, branched, and shows a marked lateral compression. It is 95 mm. high and the capitulum is 35 × 17 mm. in diameter. The stalk is 53 mm. in length and is 19 × 8·5 mm. in diameter. The capitulum is divided near its base into two large primary branches, one of which is 36 mm. in length, and 10 × 11 mm. in diameter, the other is 33 mm. in length and 14 × 11 mm. in diameter. These branches give off numerous secondary branches which vary in length and thickness. The stalk, the capitulum, and all the fairly large lobes exhibit the same lateral compression. The specimen is tough and fleshy in consistency. The lobes are soft and flexible.

The colour in spirit is bluish-green, with irregular brown patches on the stalk and about the base of the lobes. The bluish-green colour is confined to the surface of the colony and is only to be observed between the autozooids. The colour is not affected by dilute borax-carmine, but takes up Delafield's haematoxylin and alum, iron brazilin, and strong borax-carmine stains fairly readily.

The *spicules* are similar in form and size to those of other species of the genus (fig. 20). Immediately below the surface there is a thin layer of clubs averaging ·13 mm. in length by ·003 mm. in breadth, and slender spindles averaging ·07 × ·003 mm. The spicules of the coenenchym are not numerous and are all of the tuberculate warted type characteristic of the genus. The spindles average 3 mm. in length and ·4 mm. in breadth; a few are irregularly branched. The spicules of the stalk are similar to those of the capitulum.

The **autozooids** are of a pale brown colour, and are almost uniformly scattered over the whole of the capitular surface (fig. 26). There are usually from 7—8 to 10 mm. Many of the autozooids are almost fully expanded, and are situated on small raised rounded areas, which are not indicated in the drawing.

The autozooids are slightly larger than those of many species. The anthocodial portion in the preserved state is very short, being only about ·6 mm. in length, so that the crown with its eight radiating tentacles appears to be apposed to the surface of the capitulum. The average diameter of a fully expanded crown is 1·5 mm. Below the surface the diameter of an autozooid gradually diminishes posteriorly.

The *tentacles* are long compared with those of other species, and are about ·7 mm. in length when extended. They are blunt at the tip and are almost of uniform breadth. When carefully examined microscopically a double row of rudimentary pinnules may be seen down each side (fig. 27). In this respect this form resembles *Sc. capitale* and approaches *Xenia*.

The *stomodaeum* is long and convoluted, and the *siphonoglyph* is provided with long cilia. The *mesenteries* are larger and stouter in this form than in any other species in the collection. The dorsal mesenteries have large and broad, grooved mesenterial filaments, and the ventral and lateral mesenteries have longer and broader filaments than those of other species. The coelenteric cavities of neighbouring autozooids are often connected by means of short transverse vessels as in *Sarcophytum* (fig. 3). I have been unable to find male or female cells in the specimen of this species.

Siphonozooids are present but are clearly degenerate in this species, being represented by minute caeca from the large transverse vessels of the superficial canal system. They are regularly distributed in the peripheral portions of the capitulum between the autozooids. They apparently have no aperture to the exterior and therefore cannot be functional as true siphonozooids. In decalcified stained slips of tissue from the surface of the colony the caeca may be clearly seen in surface view through the ectodermal tissues, and average ·07 mm. in diameter. There is little doubt that the caeca are really very degenerate siphonozooids, for they are identical in origin with the less degenerate siphonozooids of *Sc. capitale*, *Sc. densum*, and *Sc. hirtum*, in which species the siphonozooids possess a small stomodaeum and traces of mesenteries.

Canal Systems. The transverse vessels of the superficial canal system are very pronounced but they are not quite so broad as in *Sc. capitale*, averaging ·1 mm. and lying about ·15 mm. below the surface. The vessels of the internal system are fairly numerous, and are very broad near the surface, where as in other species they usually terminate in the transverse vessels of the superficial canal system.

Zoochlorellae are very numerous in that portion of the endoderm of the transverse vessels which lies near the surface. It is so distended by their presence as to almost obliterate the lumen of the canals. They are not numerous in the vessels of the internal canal system, except where they approach the surface. They are also present in considerable numbers in the endoderm of the autozooids, but they are not so numerous in any part of the colony as they are in *Sc. gardineri*.

The *mesogloea* is diffuse and does not stain very readily with borax-carmine or haematoxylin owing to the sparcity of spicules in the lobes, it is more abundant there than in many other species.

The interesting features of this species are (1) the colony is tough and fleshy in texture; (2) the spicules are not very numerous, and are small compared with those of many other species; (3) the autozooids are fairly large. The tentacles are longer than those of any other species in the collection, and have a double row of minute pinnules down each side.

The mesenteries and mesenterial filaments are more pronounced in this than in any other species; (4) the siphonozooids are extremely degenerate and have no apertures to the exterior. They are represented by vertical caeca from the transverse vessels of the superficial canal system; (5) the transverse and internal canal systems are well-marked; (6) zoochlorellae are fairly numerous.

This species resembles *Sc. capitale* in certain respects: the tough fleshy texture of the colony; the fairly large autozooids; and the presence of a double row of rudimentary pinnules on the tentacles. It differs from that species, however, in that the mesenteries and mesenterial filaments are more strongly marked, the siphonozooids are more degenerate, and the canal system is not so clearly defined.

13. *Sclerophytum gardineri* sp. nov. (Pl. XXXI. fig. 28).

A single complete and well-preserved specimen was taken in shallow water from Hulule, Male Atoll.

The colony is 40 mm. high and is 48 × 26 mm. broad, irregularly cup-shaped and laterally compressed (fig. 28). The stalk is 20 mm. high and is 39 × 20 mm. broad, its surface is somewhat wrinkled and is hard, granular and unyielding to slight pressure. The capitulum is irregularly cup-shaped with irregular long and slender lobes, arising from the middle and edges of the cup. The cup is 40 × 31 mm. in diameter and in the middle is 20 mm. deep; there are two clefts in the sides of the cup. The lobes are brittle and are often branched. The largest lobe (*l.*) arises slightly obliquely from the middle of the cup and is 28 mm. high and 9 × 6·5 mm. in diameter near the base. It gives off numerous digitate branches which vary in length from 2 to 7 mm., but having an almost uniform breadth of 3 mm. Owing to the presence of numerous spicules the surface of the capitulum like that of the stalk is hard and granular. In spirit the specimen is of a dark cream colour.

Spicules. The hard and brittle nature of the coral is due to the presence of innumerable spicules. Clubs and slender spindles, similar to those of other species and measuring ·1—·2 mm. in length and ·05—·06 mm. in breadth, are crowded near the surface. The tuberculate spicules are similar to those of other species, the majority are spindles about 3 mm. long and ·8—1 mm. broad. A few are slightly forked as in *Sc. densum* and *Sc. hirtum.* The outer walls of the anthocodiae are studded with minute spindles as in many other species.

Autozooids only are present and the species may be regarded as having lost its siphonozooids. The autozooids are very small, and as many of them are almost completely retracted only a few can be distinguished on the surface of the capitulum (fig. 28). A fairly expanded autozooid measures ·4—·5 mm. across the crown. The tentacles are very minute, and when extended average only ·3 mm. in length. The pinnules are represented by very slight indentations of the lateral walls and are not easy to distinguish. The *stomodaeum* is fairly long, with much convoluted walls; its siphonoglyph is large and is provided with long cilia.

Mesenteries. The dorsal mesenteries are clearly marked and are very long; they are provided with long, broad grooved and ciliated mesenterial filaments, which are much convoluted at the beginning of their course. Ventral and lateral mesenteries are present but below the stomodaeum diminish rapidly in size, and consequently have a very short free edge with no filaments. Ova in all stages of development are present, and are frequently to be found on the dorsal mesenteries. In this respect this species is interesting, for ova

are usually only found on the ventral and lateral mesenteries, and I believe have not been observed hitherto on the dorsal mesenteries in any species of the Alcyonaria.

Zoochlorellae are very numerous in the endoderm of the tentacles, and are present, but less abundant, in the endoderm of the mesenteries and in the coelenteric cavity of the zooids.

Canal Systems. The vessels of the superficial canal system are broad and fairly numerous. The transverse vessels lie in the mesogloea about ·07 mm. below the surface and are about ·1 mm. in diameter. Both endoderm and lumen of these canals are densely crowded with zoochlorellae, which are also present but are not so numerous in the vessels near the surface of the internal system, which is similar to that of other species.

A study of the anatomy of this species reveals many interesting features, which may be briefly summarised. The autozooids are very small and are less numerous than in many other species. In certain respects they show unmistakable signs of degeneration:—(1) the tentacles are very short, blunt, inflexible, and are only very slightly pinnate; (2) the ventral and lateral mesenteries are very feebly marked, and (3) have no mesenterial filaments. On the other hand the siphonoglyph of the stomodaeum, the dorsal mesenteries and their filaments are all strongly marked. The occurrence of ova on the dorsal mesenteries is also interesting, but is probably an aberrant feature, as they have not to my knowledge been previously observed on the dorsal mesenteries in any species of the Alcyonaria.

The degenerate character of the food-capturing and digestive portions of the zooids is doubtless correlated with the presence of vast numbers of zoochlorellae in the endoderm and lumen of the superficial canals and in the endoderm of the zooids, for in no other species are the zoochlorellae so numerous nor the degeneration of the zooids so marked. It is possible that the absence of siphonozooids may also be correlated with the strongly marked character of the ciliated portions of the autozooids. In the absence of ventral and lateral mesenterial filaments, and of siphonozooids, and the presence of a well-marked superficial canal system this species resembles the genus *Xenia*.

14. *Sclerophytum durum* sp. nov. (Pl. XXXI. figs. 29—32).

Four specimens were taken. Three of them have a cup-shaped capitulum with marginal lappets; one of these has a rhizome-like outgrowth from the stalk which serves for additional fixation (fig. 30 *rh*). The fourth specimen (fig. 29) is the largest and probably the oldest, for ova are present at an advanced stage of development. This specimen is not cup-shaped, but is proportionately shorter and stouter than the others and has a much lobed capitulum, so that the specific identity of the four specimens was not easy to recognise. Careful and minute examination, however, shows the difference to be one of facies only, for the anatomy of all the specimens proved to be identical. All the specimens are extremely hard and brittle. Enormous spicules (fig. 31 *sp*) can be seen lying parallel to the surface through the ectodermal tissues.

One cup-shaped specimen creamy-white in colour (in spirit) was taken near Nilandu at a depth of 24 fathoms. Two cup-shaped specimens, one of which has a double cup, dirty yellow in colour (in spirit), were taken on the Mahlos Atoll in shallow water. The lobed specimen of a pale brownish-grey colour in spirit was taken on Addu Atoll, also in shallow water. The specimens vary from 30 to 50 mm. in height, their capitula from 27 to 45 mm. in diameter. Two of the specimens have slender, and two have broad stalks, the stalk of the lobed specimen being proportionately shorter and broader than that of the rest.

Spicules. The species is characterised by the enormous spicules which occur throughout the colony and can be seen with ease through the ectodermal tissues (figs. 29 and 30 *sp*). The largest are all spindles of the tuberculate type (fig. 31). These spicules have an important bearing upon the form of the colony in that they materially affect its outline. Small clubs are numerous near the surface as in other species. The tuberculate spindles vary in size from 1·5 × ·5 mm. to 7 × 1·7 mm. (fig. 31). They are often somewhat irregular in form; they may be sharply pointed or blunt at each end, many are ridged and are three-sided, some are crescentic, many are curved. All the large spicules are unbranched, in this respect the species differing from any other in the collection.

When a spicule is seen with the naked eye the general outline appears smooth and unbroken, when examined with a lens the surface appears granular (fig. 31), but when subjected to higher magnifications the granules are seen to be tiny tuberculate warts regularly arranged (fig. 31 *b*, and *c*), averaging ·09 mm. across. A few spindles occur here and there with a few tubercles.

Packed closely near the surface are the small clubs and a few minute spindles with few tubercles, and a very few irregular tuberculate dumb-bells about ·1 mm. in length and ·08 mm. in breadth. The clubs are knotted and of varied shape, ·12—·24 mm. long and about ·02 mm. broad (fig. 32 *a*, *b*, *c*, *d*, *e*). They are apparently the only branched spicules in the species.

The **autozooids**, most of which are completely retracted in all the specimens, are more numerous on the lobed (fig. 29) than the cup-shaped specimens, but are proportionately fewer in this than in any other species of the genus which I have examined. This may, to a great extent, be due to the presence of numerous large spicules which run immediately below but parallel with the surface. The autozooids are very minute, and in the retracted state their apertures are difficult to distinguish even with a lens. In the cup-shaped specimens the polyps appear to be most numerous on the margin of the capitulum. The diameter of a polyp cavity when the polyp is completely retracted is ·25—·5 mm. The *tentacles* are extremely short and stumpy, and only very slightly pinnate. They possess spicules in the form of extremely small spindles. The *stomodaeum* is long, measuring about ·85 mm. It is slightly convoluted in the preserved state; the siphonoglyph is fairly well-marked. The 8 *mesenteries* are very slender, but are clearly marked. All of them have mesenterial filaments.

The two dorsal mesenterial filaments are of considerable length and are grooved and ciliated as in other Alcyonaria. The ventral and lateral mesenterial filaments are extremely short and are confined to that portion of the autozooid immediately below the stomodaeum. They are similar in form and anatomy to those of other Alcyonaria. Typical Alcyonarian ova, ·3—·5 mm. in diameter, are present in the mesenteries.

The **siphonozooids** are extremely degenerate in this species, and are represented by small caeca from the superficial transverse canals.

Canal Systems. The superficial canal system is strongly marked. The large transverse vessels run in a sinuous course immediately below the ectodermal tissues. Many of the canals are closely apposed on their internal side to the enormous spicules which in this species lie so near the surface. These canals have very short vertical caeca towards the surface but they are shorter than *Sc. polydactylum* and are homologous to the degenerate siphonozooids in other species. The superficial canal system has numerous communications with the internal canal system, which is not so strongly marked as in other species.

Zoochlorellae are present in that portion of the endoderm of the transverse canals which lies nearest to the surface, but they are not numerous, few are to be found in the lumen of the canals.

Owing to the great amount of space occupied by the spicules the supply of mesogloea is less abundant than in other species, but it is of a very dense nature and stains very readily.

15. *Sclerophytum querciforme* sp. nov. (Pl. XXXI. fig. 33).

Two complete colonies were taken in shallow water on Hulule, Male Atoll. Both specimens are arborescent and are very similar in their manner of growth. Each is comparatively tall and slender, with a much branched capitulum, many of the branches having long and slender lobes. From near the base of the larger specimen a second stalk grows out bearing a small branched capitulum (fig. 33).

The larger colony is 46 mm. high. The stalk is cylindrical above the junction of the secondary stalk and elliptical in cross section below. At the top the stalk is branched and passes almost imperceptibly into the capitulum, which is 20 mm. high and 25 × 18 mm. in diameter, being slightly compressed laterally. The branches vary very considerably in size, but the two principal branches are 10 and 12·5 mm. long and about 4 mm. broad. The lobes are very slightly flexible. The surface of the capitulum and stalk is granular and fairly hard to the touch, but yields to slight pressure. The specimens in spirit were of a pale greenish-grey which gradually changed to a deep cream colour.

The **spicules** are very similar in form and structure to those of other species. Clubs are very numerous near the surface, ·2—·26 mm. long by about ·008 mm. in greatest breadth. The tuberculate spicules vary in size, the largest being fully 6 mm. long by 1 mm. broad. A few forked spicules occur but are not numerous.

There are no *siphonozooids* in this species.

The **autozooids** are fairly numerous and are all of one kind. Most of them are completely retracted. An autozooid cavity is ·4—·5 mm. in diameter just below the surface. The *tentacles* are very short and pinnate. The pinnules are proportionately longer in this than in any other species in the collection.

The *stomodaeum* is long; the siphonoglyph is well-marked and is provided with very long cilia. The *mesenteries* are all strongly marked and are all provided with mesenterial filaments; the dorsal mesenterial filaments are long, grooved and ciliated as in other species. The ventral and lateral mesenterial filaments are not so long nor so broad as the dorsal filaments; they are more or less rounded in cross section and are similar in form and structure to those of *Sc. palmatum, capitale, hirtum,* and of many other Alcyonaria, but both mesenteries and filaments are longer and broader than in many species of the genus.

Canal Systems. The vessels of the superficial system are not so large nor so numerous as in other species in the collection. The transverse vessels lie about ·25 mm. below the surface and have no vertical caeca, but follow a course almost parallel with the surface. As in other species, these vessels communicate with the coelenteric cavities of the autozooids and with many vessels of the internal system, which is very similar to that of other species, but less strongly marked.

Zoochlorellae are fairly numerous in the endoderm and lumen of the canals and in the endodermal tissues of the autozooids.

	Texture of colony	comparatively soft and fleshy	hard, granular	tough, fleshy	tough, fleshy	tough, fleshy	hard, brittle	extremely hard and brittle	hard lobes slightly fleshy
Spicules	Clubs and spindles near surface	numerous	numerous	numerous	numerous	less numerous	densely crowded	numerous	numerous
Spicules	Tuberculate spicules	not very numerous and small, 1—2·5 mm. in length	very numerous, 2—4 mm. long	numerous, 1—4 mm. long	numerous small, about 2 mm. long	not numerous, average 3 mm. in length	very numerous, average 3 mm. in length	very numerous, very large, 1—7 mm. in length	numerous large, 1—6 mm. in length
	Zooids	dimorphic	dimorphic	dimorphic	siphonozooids very degenerate	dimorphic	siphonozooids absent	siphonozooids very degenerate	siphonozooids absent
Autozooids	Size	fairly large	smaller than *capitale*	...	very small	larger than in other species	very small	very small	small
Autozooids	Diameter of expanded crown	1 mm.	...	·8 mm.	...	1·5 mm.	·4—·5 mm.	...	...
Autozooids	Diameter of contracted autozooid just below surface	...	·75 mm.	...	·5 mm.	...	...	·25—·5 mm.	·4—·5 mm.
Autozooids	*Tentacles*	broadest at tip	bluntly conical	bluntly conical	retracted	...	...	retracted	retracted
Autozooids	Length	·45 mm.	·4 mm.	...	...	·7 mm.	·3 mm.	...	...
Autozooids	Pinnules	double row	...	single row	...	double row	very rudimentary	...	...
Autozooids	Mesenteries	well marked	long and slender	long and fairly broad	long, slender	larger than in other species	only dorsal clearly marked	slender	well marked
Autozooids	Ventral mesenterial filaments	short	very short	longer than in many species	short, feebly developed	fairly long and broad	absent	very short, feebly marked	fairly long and broad
Autozooids	Reproductive organs	not observed	ova in all stages	not observed	not observed	not observed	*ova occur on dorsal mesenteries*	ova present	not observed
Siphonozooids	Size	larger than in any other species, average ·3 mm. in length	average ·17 mm. in length	average ·1 mm. in length	*siphonozooids* represented by caeca from transverse canals	average ·17 mm. in length	absent	*siphonozooids* represented by very short caeca from transverse canals	absent
Siphonozooids	Stomodaeum	rudimentary	very rudimentary, apertures usually rounded	rudimentary, apertures keyhole shaped	...	no apertures	...	...	...
Siphonozooids	Mesenteries	traces	traces	traces in some cases	...	absent	...	...	...
Canal Systems	Superficial	extremely well marked, vessels very numerous, ·07—·3 mm. broad	well marked, vessels very numerous, average ·08 mm. broad	well marked, vessels numerous, average ·07 mm. broad	very well marked, vessels average ·16 mm. broad	well marked, vessels average ·1 mm. broad	well marked, vessels average ·1 mm. broad	well marked, vessels average ·09 mm. broad	not so well marked as in other species
Canal Systems	Internal	well marked vessels numerous and very large near surface	well marked vessels numerous	well marked, vessels broader near surface	well marked	well marked	well marked	fairly well marked	not so well marked as in other species
	Zoochlorellae	not numerous	numerous near surface	numerous in endoderm but few in lumen of canals	fairly numerous	very numerous in endoderm and in lumen of canals	extremely numerous, lumen of canals completely obliterated	not very numerous, few in lumen	fairly numerous in endoderm and lumen of canals
	Bathymetric records	shallow water	from shallow water to 34 fathoms	shallow water	25 fathoms	shallow water	shallow water	from shallow water to 24 fathoms	shallow

The *mesogloea* is fairly dense owing to the presence of numerous large spicules, it is less abundant than in the soft, fleshy species.

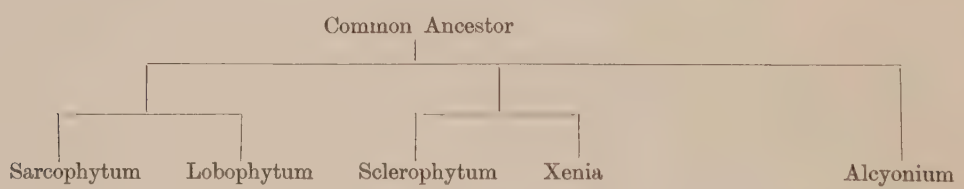
The interesting features of the species are: (1) the erect arborescent form of the colony (fig. 33); (2) the presence of numerous very large tuberculate spicules; (3) the absence of siphonozooids; (4) the well-marked character of the zooids, the mesenteries and their filaments large compared with many other species; (5) the comparatively feeble development of the superficial and internal canal systems; (6) zoochlorellae present but not in considerable numbers.

V. THE RELATIONS OF THE ABOVE GENERA.

Sclerophytum differs from *Alcyonium* in (1) the form and size of the spicules; (2) the small size of the zooids; (3) the occurrence of dimorphism in many species; (4) the presence of a special superficial canal system; (5) the small size or complete absence of ventral and lateral mesenterial filaments. These important points of difference indicate a very distant relationship between *Sclerophytum* and *Alcyonium*.

A study of Table II. shows that while specimens of *Sclerophytum* and *Lobophytum* may be similar in outward form, yet there are many striking points of difference in their internal anatomy. The general anatomy of *Lobophytum*, however, is very similar in many respects to that of *Sarcophytum*, with which it appears to be closely allied.

Some of the important anatomical points of difference between *Sclerophytum* and the two genera *Sarcophytum* and *Lobophytum* are: (1) the presence in *Sclerophytum* of more than one row of pinnules on the tentacles; (2) the ventral and lateral mesenterial filaments are always very feebly marked (but are absent in *Sc. gardineri*); (3) the presence of a special superficial canal system; (4) the absence of dimorphism in some of the species. In all these respects *Sclerophytum* approaches the genus *Xenia*. The following diagram suggests the probable relationship between the four genera and *Alcyonium*.



Mr Gardiner has given me the following note of the distribution of the genera *Sarcophytum*, *Lobophytum*, and *Sclerophytum* in the Maldives:—"They are found on nearly every reef in the Maldives but are most common on the reefs which fringe the passages into atolls. Under no circumstances are they ever found covering great areas, as Saville Kent says is the case with *Sarcophytum* on the Great Barrier Reef of Australia. They do not generally occur on shoals in the lagoonlets of secondary atolls (velu of faro), nor are they found on any reef more than 100—150 yds. from its outer edge. In the more enclosed atolls such as Goifurfehendu, Addu, Kolumadulu, and Haddumati, these genera are scarce, only small colonies being found on the reefs arising within their lagoons.

"The genera are common on the reefs of Hulule faro, Male Atoll. They live very abundantly on the outside part of the west reef and form large spreading masses. On the

Table II. Comparison of the General Anatomy of the three Genera.

Genus	*Sarcophytum*	*Lobophytum*	*Sclerophytum*
Form of Colony	usually mushroom-shaped throughout life (fig. 1)	young colonies may be mushroom-shaped (fig. 12), older forms have a much lobed capitulum (fig. 7)	as in *Lobophytum* (figs. 18 and 23)
Spicules	clubs, rods, and spiny spindles usually not zoned	small zoned spindles, few clubs	usually large tuberculate spicules of varied form, may not be zoned, clubs usually numerous near surface
Zooids	dimorphic	dimorphic	often dimorphic
Growth of colony by formation of new autozooids	most vigorous on the margin, hence mushroom-shape	may take place from any part of capitular surface, gives lobed form	as in *Lobophytum*
Distribution: (1) of autozooids	most numerous on margin, fewest in middle of capitulum (fig. 9)	more or less regularly on surface of capitulum, least numerous on margin	as in *Lobophytum*
(2) of siphonozooids	least numerous on margin, elsewhere regularly arranged (fig. 9)	usually most numerous on margin, elsewhere regularly arranged (fig. 7)	imperceptible to naked eye
Autozooids:	fairly large, pinnate, only one row of pinnules	similar to *Sarcophytum*	very small, in some cases slightly degenerate
Tentacles	,, ,,	,, ,,	short, stumpy, in some cases a double row of very small pinnules
Stomodaeum	long, convoluted	,, ,,	comparatively long
Siphonoglyph	not well marked	,, ,,	very well marked
Mesenteries	all well marked	all well marked	in some cases ventral and lateral feebly marked
Dorsal mesenterial filaments	well marked	,,	well marked
Ventral and lateral mesenterial filaments	fairly large	as in *Sarcophytum*, differ slightly in size	very short and feebly marked or absent
Siphonozooids:	comparatively large	as in *Sarcophytum*, differ slightly in size	very small and rudimentary or absent
Canal Systems	one internal well marked	one as in *Sarcophytum*	two internal, well marked, and a *Special Superficial Canal System* intimately connected with rudimentary siphonozooids
	ciliated channels between autozooids numerous (fig. 3)	ciliated channels as in *Sarcophytum* but not so numerous	few ciliated channels between autozooids
Zoochlorellae	fairly numerous in endoderm of siphonozooids and autozooids	not numerous	extremely numerous in superficial canals and endoderm where there are no ventral and lateral mesenterial filaments, less numerous where they are present

boulder zone W. and S.W. small clumps occur, but it is obvious that the best position of growth is a little further out towards the atoll lagoon, where even at the lowest tide there is 3—6 feet of water. Everywhere colonies are scarce within the boulder zone and are never found on the sand. A brilliant green species (*Sarcophytum glaucum*) alone inhabits the east and south sides of the faro; it ranges from the more external parts of the sand-flat even to the extreme edge of the reef-flat where the waves break.

"Exposed to the air and sun colonies will continue to live so long as portions of them are bathed by the water, even for 3—4 hours. Torn off their support they may be kept alive for an hour or so in a bag or any receptacle which will prevent evaporation. In a mixed bucket of animals from any reef (enamelled bucket) the colonies will rarely live beyond an hour or two, but separate colonies can be kept alive for several days. Anaesthetisation with cocaine is useless, the chemical encouraging disintegration of the tissues; alcohol sometimes yields good results, as also does chloral hydrate."

VI. GENUS ALCYONIUM.

Wright and Studer distinguish between *Alcyonium* and *Lobularia* on the ground that Alcyonium is restricted to temperate seas, while *Lobularia* occurs only in tropical waters. This distinction cannot be maintained, for in the collection is a single but excellently preserved specimen which appears to be identical with Klunzinger's *Alcyonium pachyclados* (1879, p. 24, Taf. 1, fig. 5) from the Red Sea. Hickson (1900, p. 72) records from the Cape of Good Hope the occurrence of a form similar in so many respects that he refers it to this species. I have been able to compare these specimens with the one from the Maldives and with another tropical form taken by Willey in New Britain. All the specimens agree in the character and form of the spicules and apparently in their general and minute anatomy, but differ in form and colour, so that it is very probable that they are different facies of the same species. The generic identity of these forms from temperate and tropical waters is indisputable, so that *Alcyonium* can no longer be regarded as an extra-tropical genus. The vague definition of *Lobularia* has led to much confusion among systematists, some writers including it with *Alcyonium* and not regarding it as a true genus.

Alcyonium is well known to be a monomorphic genus. Whitelegge (1897, p. 220) describes a lobed form with well-marked dimorphism from Funafuti which he doubtfully refers to *Lobularia* as *L. ? viridis* (Quoy et Gaim.). His description of this form, and his drawings of the spicules indicate it to be a species of the genus *Lobophytum* which I have attempted to revise in the present paper (p. 514). It is probable that other species of *Lobularia* which have not been attributed to *Alcyonium* will eventually be included in the new genus *Sclerophytum* (p. 516). The vague, confusing, and useless diagnosis of *Lobularia* makes it imperative that it should be deleted as a genus from the family of the Alcyonidae.

16. *Alcyonium pachyclados* Klz.

A single well-preserved specimen agreeing with Klunzinger's description (1879, p. 24, Taf. 1, fig. 5) was taken from the reef of Naifaro, Fadifolu Atoll.

The colony from which the stalk is missing grows irregularly, and the bluntly digitate lobes with their short, blunt, closely set branches vary considerably in length. This specimen

differs from the Cape specimens in form and colour. The Cape specimens are all more arborescent with longer and more slender branches.

The Maldive Island specimen in spirit is of a pale brownish-grey colour, paler on the tops of the lobes than in the furrows between. The specimens from the Cape, three in number, are all different in colour, one white, one red, and the third yellow. This difference is due to the difference in colour of the spicules. The form and character of the spicules in all cases is identical. The elliptical and opaque spicules described by Klunzinger were present in the Maldive Island specimen, but I have not been able to find them in the Cape specimens.

The general and minute anatomy of all the specimens is very similar to that of *Alcyonium*. Ova are very numerous on the mesenteries, the largest being ·45 mm. in diameter. The nutritive canal system differs from that of *Sclerophytum* in the absence of a special transverse superficial canal system.

The research in connection with this paper has been carried out in the Zoological Laboratories of the Owens College, under the supervision of Professor Hickson, to whom I am greatly indebted for much valuable assistance and advice.

My thanks are also due to Professor Herdman in allowing me to examine his valuable collection of Alcyonidae from Ceylon.

VII. LITERATURE.

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EXPLANATION OF PLATES XXVIII—XXXI.

ap.c. = aperture of canal.
au. = contracted autozooid.
e.au. = expanded autozooid.
c.c. = coelenteric cavity.
cap. = capitulum.
cap.mar. = capitular margin.
cl. = clubs.
c.v. = ciliated vessel.
d.m.f. = dorsal mesenterial filament.
ect. = ectoderm.
end. = endoderm.
end.b.w. = endoderm of body wall.
end.can. = endodermal canals in mesogloea.
g.c. = golden cells.
in.c. = vessel of internal canal system.
in.lob. = internal lobe of capitulum.
l.c. = longitudinal canals.
l.m.f. = lateral mesenterial filament.
l. = lobe.
m. = mesentery.
m.ap. = mouth aperture.
mar.lob. = marginal lobe of capitulum.
mg. = mesogloea.
mg.c. = mesogloeal cells.
mg.d. = dense layer of mesogloea surrounding siphonozooids.
rh. = rhizome.
s. = stomodaeum.
si. = siphonozooid.
sp. = spicule.
sp.h. = hole left by spicule after decalcification.
st. = stalk.
tent. = tentacle.
ts.s.c. = transverse superficial canal.
v.m.f. = ventral mesenterial filament.
zo. = zoochlorellae.

Fig. 1. *Sarcophytum ehrenbergi.* × 2. The mushroom-like form is characteristic of the genus. The autozooids are most numerous on the margin of the capitulum where the siphonozooids are few in number. The downward and inward curve of the margin is shown. Many of the autozooids are almost completely retracted, but a few partially expanded ones are to be seen on the margin and upper part of the capitulum.

FIG. 2. Surface view of a portion of the capitulum of the same species showing two autozooids, one expanded, the other contracted. Small spicules are seen imbedded in their walls. Spicules are also numerous in superficial tissues between the zooids and are seen by transparency of the ectoderm. The mesenteries of the siphonozooids may be seen through the ectodermal tissues. × 20.

FIG. 3. *Sarcophytum glaucum.* A ciliated canal connecting the coelenteric cavity of an autozooid with that of a siphonozooid. × 300. Running at right angles to the ciliated canal is a longitudinal canal of the internal canal system, which in the preserved condition appears to be unciliated; this canal also opens into the coelenteric cavity of the autozooid.

FIG. 4. Group of rounded golden cells in same species with granular yellow contents in internal canal system. × 620.

FIG. 5. *Sarcophytum plicatum.* Spicules. × 60. (This species was not in the collection, but the drawing is inserted because the spicules are tuberculate and approach *Sclerophytum* in form.)

FIG. 6. *Sarcophytum tenuis* sp. nov. Spicules. × 120. *a* = a slender spindle to be found in the coenenchym and on the anthocodia of the autozooids. *b* = slender clubs from the coenenchym. *c* = small club to be found in the periphery of the capitulum and in the stalk.

FIG. 7. *Lobophytum pauciflorum.* A colony characteristic of the genus. × 2. As all the specimens in the collection of fairly large colonies are fragmentary, a drawing was therefore made of a complete specimen from New Britain, which agrees with the specimens from the Maldives in all essential details. The lobed appearance of the capitulum is due chiefly to the formation by budding of new autozooids at any portion of the capitular surface. In this genus the siphonozooids are most numerous on the marginal seam of the capitulum. The marginal lobes differ from the inner lobes in the proportionately greater number of siphonozooids compared with the number of autozooids on their surface.

FIG. 8. *Sclerophytum capitale* sp. nov. A complete colony. × 2. Many of the autozooids are fairly expanded.

FIG. 9. *Sarcophytum tenuis* sp. nov. × $1\frac{1}{3}$. Only the upper surface of the slightly concave capitulum is shown. Autozooids are very numerous round the margin forming a thick fringe. In the middle of the capitulum they are much fewer in number. Siphonozooids are indicated as dots between the autozooids, they are much more numerous in the actual specimen.

FIG. 10. *Sarcophytum roseum* sp. nov. Spicules. × 120. The spicules are slightly zonate, and in this respect approach *Lobophytum.* I, II, III are taken from near the surface of the capitulum, IV, V, VI and VII from the coenenchym of the capitulum.

FIG. 11. A portion of the capitulum of the same species. × $1\frac{1}{3}$. All the autozooids are contracted. The capitulum is thickest in the middle and thins out towards the margin, and therefore has no capitular fold as in "*ehrenbergi*" (fig. 1). Siphonozooids are indicated as small dots between the autozooids.

FIG. 12. *Lobophytum pauciflorum.* Young mushroom-shaped colony. × 2.

FIG. 13. Surface view of tip of lobe of capitulum of same species, showing three autozooids and surrounding siphonozooids. × 30. One autozooid is fairly expanded.

Fig. 14. Longitudinal section through four siphonozooids of the same species (Si_1, Si_2, Si_3, Si_4), showing ciliated vessels connecting the coelenteric cavities. The section passes through the siphonoglyph of the first siphonozooid. Only the left half of the fourth siphonozooid is indicated.

Fig. 15. *Sclerophytum capitale.* Clubbed spicule. These are very abundant near the surface of the colony. × 219.

Fig. 16. Different forms of the tuberculate spicules to be found in a single colony of the same species. × 20. (Regular spindles, similar to those of other species, are also numerous, but they are not figured.)

Fig. 17. Surface view of a portion of the capitulum of the same species, showing arrangement of siphonozooids between two autozooids. × 45. One of the autozooids is partially contracted, the other is fairly well expanded. The tentacles have a double row of small pinnules down each side.

Fig. 18. *Sclerophytum densum.* Young colony, showing formation of primary lobes from the margin of the capitulum. The colony has not yet lost its mushroom-like form. The surface of the capitulum is slightly concave. The siphonozooids are very minute and are not indicated in the drawing. × $1\frac{1}{3}$.

Fig. 19. *Sclerophytum capitale* (sp. nov.). Drawing of a fairly thick free-hand section through a lobe of the capitulum of the same species. × 65 (Cam. Lucida). The drawing shows the rudimentary siphonozooids which terminate posteriorly in the transverse vessels of the superficial canal system. The vessels of this system communicate with those of the internal canal system, and directly or otherwise with the coelenteric cavity of the neighbouring autozooid.

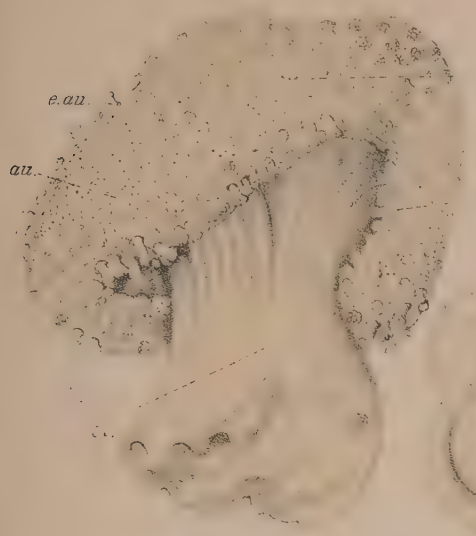
Fig. 20. *Sclerophytum densum. a, b, c, d, e.* Different forms of tuberculated spicules characteristic of the genus. × 10. *f.* A forked spicule with irregular tubercles. *g, h.* Two tubercles seen laterally. × 300 (Cam. Luc.).

Fig. 21. Longitudinal section through a single degenerate siphonozooid of same species. × 730. The section passes through the mouth aperture of the siphonozooid. The stomodaeum is extremely short in this specimen. A deeply staining layer of dense mesogloea surrounds the siphonozooid internally. The siphonozooid passes posteriorly (on the left) into a superficial transverse vessel. The endoderm lining the coelenteric cavity is distorted by the presence of numerous zoochlorellae. An aggregation of endodermal cells near the stomodaeum is probably a degenerate mesentery.

Fig. 22. A partially retracted autozooid of same species. The drawing was made from a fairly thick freehand longitudinal section stained with borax carmine. The figure shows the intimate connection between the coelenteric cavity of the autozooid and the lumen of the canals, and also with the coelenteric cavity of the degenerate siphonozooids. The long stomodaeum is shown (dotted shading). The ventral and lateral mesenterial filaments are very short. The dorsal mesenterial filament is long, ciliated, and grooved.

Fig. 23. *Sclerophytum hirtum.* Drawing of a colony to show lobation of capitulum. × $1\frac{1}{3}$. Most of the autozooids are partially expanded.

Fig. 24. Spicules of same species. *a, b, c, d,* tuberculate spicules; *e, f,* clubs.



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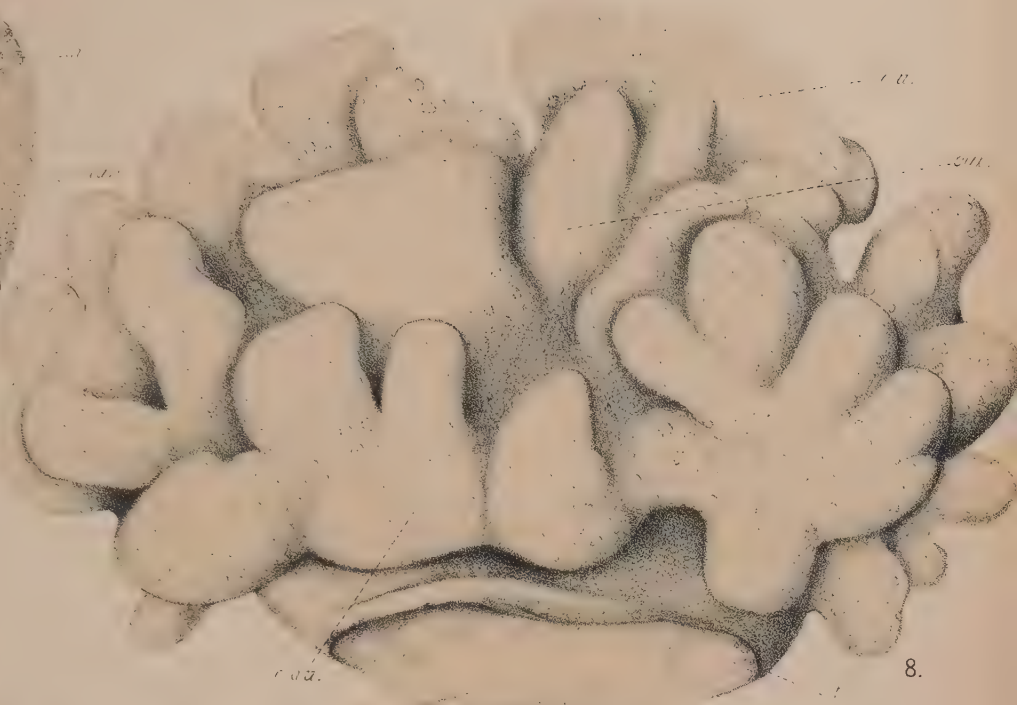

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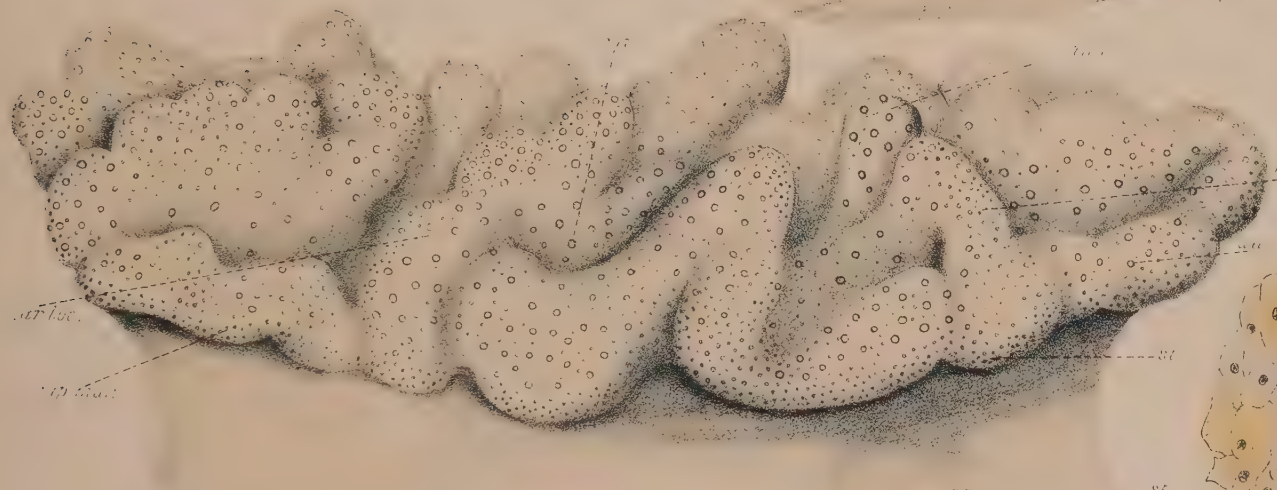

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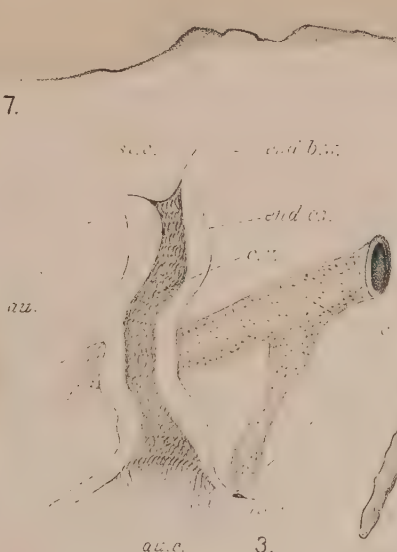

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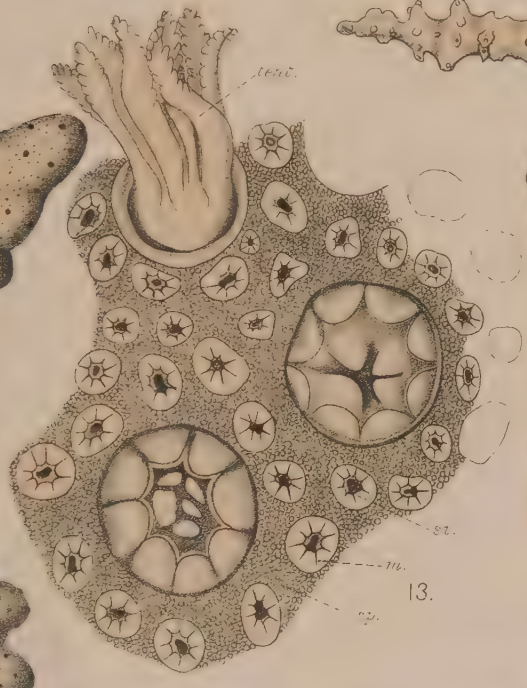

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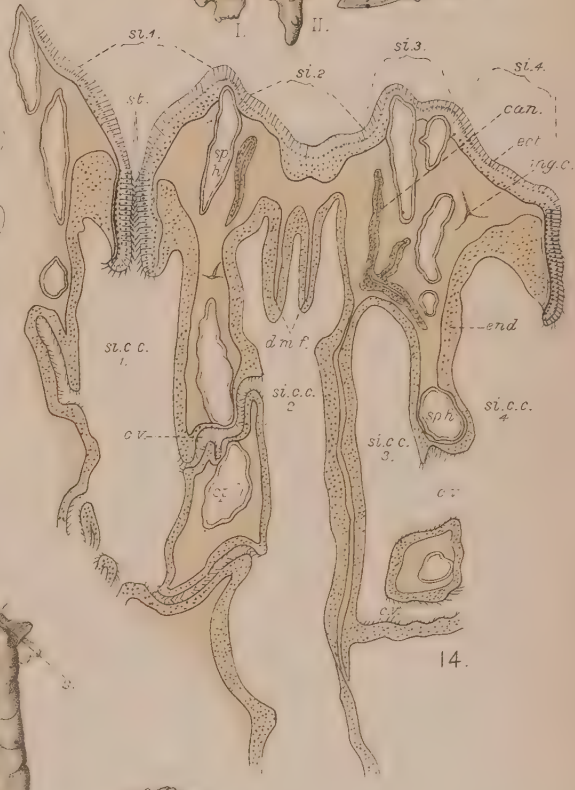

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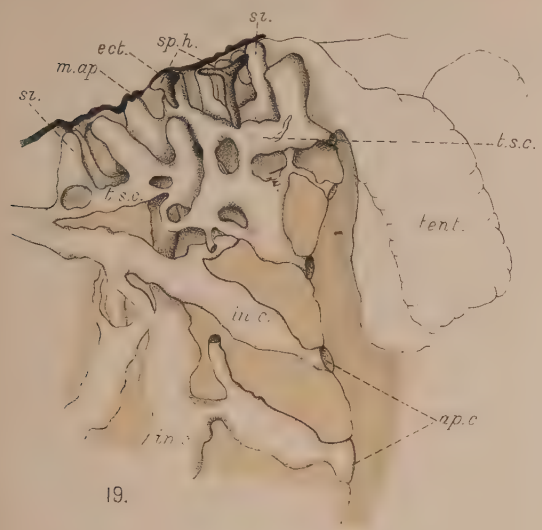

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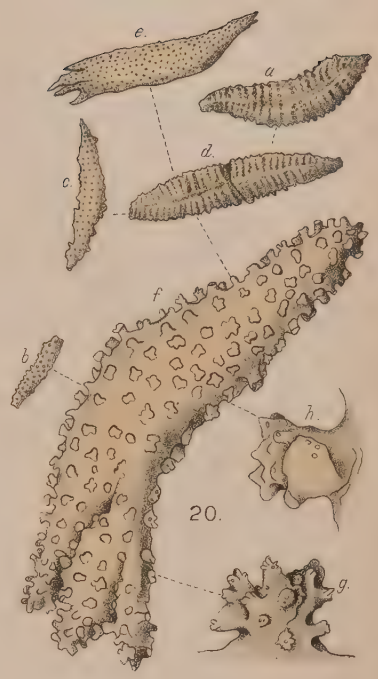

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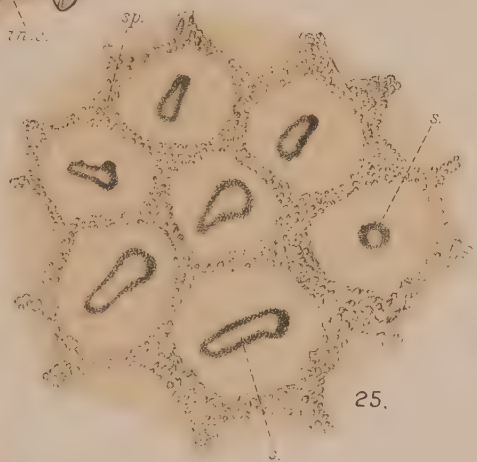

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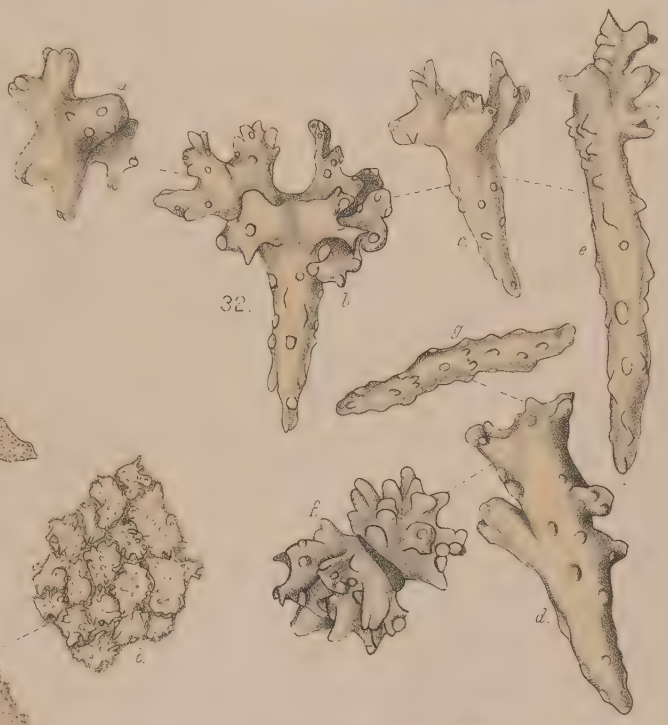


E.M.P. & E.D. del.

E.Wilson, Cambridge

Pratt - Alcyonaria.

FIG. 25. Group of rudimentary siphonozooids of same species. Surface view of stained preparation. × 90. The drawing shows the degenerate stomodaeum with mouth aperture (Cam. Luc.).

FIG. 26. *Sclerophytum palmatum* sp. nov. Drawing of a colony to show branching of capitulum. Many of the autozooids are expanded. Natural size.

FIG. 27. A tentacle of autozooid of same species, showing double row of rudimentary pinnules down each side. (× 60 Cam. Luc.)

FIG. 28. *Sclerophytum gardineri* sp. nov. Drawing of a colony. × 2. The colony is laterally compressed and is irregularly cup-shaped, with lobes arising from the middle and edges of the cup. The autozooids are small and are not numerous. Siphonozooids are absent.

FIG. 29. *Sclerophytum durum* sp. nov. A lobed colony. × $1\frac{1}{3}$. All the autozooids are retracted. The enormous spicules characteristic of this species can be seen through the ectodermal tissues of the capitulum. They are also shown protruding from the base of the stalk.

FIG. 30. A younger cup-shaped colony of same species with rhizome-like outgrowth from the stalk. × 2. A few very small lobes are seen arising from the basin of the capitulum. The autozooids in this specimen are apparently most numerous round the margin of the capitulum.

FIG. 31. Tuberculate spicules of same species. *a*. A single tuberculate spindle. × 10. *b*. A portion of the tuberculate surface of the same spicule, more highly magnified. × 80. *c*. Tip of a more pointed spindle showing tuberculate warts. × 8. *d*. × 6 (Cam. Luc.).

FIG. 32. Spicules of same species; numerous near surface of colony. *a*, *b*, *c*, *d*, *e*. Different forms of clubbed spicules. All these forms are common. *a*, *b*, *c*, × 290, *d*, × 270, *e*, × 250. *f*. An irregular tuberculate dumb-bell (rare). × 270. *g*. An irregular spindle with small spines. × 250.

FIG. 33. *Sclerophytum querciforme* sp. nov. A colony with a secondary stalk and capitulum. × 2. The large tuberculate spicules are seen protruding from the base of the stalk. The stalk is branched at the top and passes almost imperceptibly into the capitulum.

NUDIBRANCHIATA,

WITH SOME REMARKS ON THE FAMILIES AND GENERA AND DESCRIPTION OF A NEW GENUS, *DORIDOMORPHA*[1].

By Sir Charles Eliot, M.A., K.C.M.G.,
Commissioner of the British East Africa Protectorate.

(With Plate XXXII.)

The Nudibranchs described in the present paper represent the collections made by Mr J. Stanley Gardiner in the Maldive and Laccadive Islands (1899—1900). I have added descriptions of two other remarkable specimens with which he has furnished me, one (*Doridomorpha Gardineri*) obtained by himself at Rotuma in 1896, and the other (*Pleuroleura striata*) by the Skeat Expedition from Pulan Bidang in the Malay Peninsula (1899). The specimens from Minikoi (Laccadive Islands) were all reef forms: those from the other localities were largely dredged. In only a few cases are there any notes as to the colour or appearance of the living animals: as preserved they have, with a few conspicuous exceptions, lost entirely their original colour and assumed the dirty yellowish tinge common in alcoholic specimens. They have also in many cases been strongly contracted and distorted by the action of the preserving medium. I have therefore felt very diffident in creating new species, and have perhaps erred on the side of identifying specimens with the most similar forms already described. But I think it useless to create new species of Nudibranchs unless it is possible to formulate the specific characters. The fact that an alcoholic specimen does not seem quite the same as those already described is not sufficient to give it specific rank.

Besides forms common in the Indo-Pacific region, the present collections contain a number which confirm the descriptions by previous authors of species established on the strength of one or a few specimens, and also offer some novelties. Of these the most interesting is *Doridomorpha*, a small Dorid without gills, related to *Doridoxa* Bgh. There are also a large and well-preserved *Notodoris*, which appears specifically distinct from *N. citrina*, for which Bergh established the genus: a new species of *Dictyodoris*: a form

[1] [This paper was received in June, 1902, though only published now. The author has since published descriptions of some of the species noticed here, which may bear an earlier date than the present volume but are really later. Ed.]

to which I hesitate to give generic rank and somewhat doubtfully refer to *Staurodoris*, liberally interpreted: and a remarkable specimen of the *Hexabranchidae*, which has been greatly distorted, but seems at least specifically distinct. The rediscovery of *Pleuroleura striata*, v. Hass., is also interesting.

The list of genera and species is as follows:

HOLOHEPATICA.

1. *Marionia arborescens* B.
2. **Doridomorpha gardineri* nov. gen., nov. sp.
3. *Hexabranchus faustus* B.
4. „ *digitatus* nov. sp.
5. *Notodoris gardineri* nov. sp.
6. *Trevelyana crocea* B.
7. *Nembrotha nigerrima* B. ? var.
8. *Chromodoris elizabethina* B.
9. „ *rosans* B.
10. „ *pustulans* B.
11. *Ceratosoma trilobatum* Gray.
12. „ *gracillimum* Semper.
13. *Discodoris concinna* (A. and H.).
14. „ *pardalis* (A. and H.) ?
15. *Discodoris meta* B.
16. *Platydoris eurychlamys* B.
17. „ *scabra* (Q. and G.).
18. „ sp.
19. *Dictyodoris maculata* nov. sp.
20. *Staurodoris pecten* nov. sp.
21. *Trippa ornata* B.
22. *Doridopsis nigra* Stimpson, var. *nigerrima* B.
23. „ *apicalis* B. ?
24. *Phyllidia varicosa* Lam.
25. „ *elegans* B.
26. *Fryeria rüppelii* B.
27. *Phyllidiopsis striata* B. ?

CLADOHEPATICA.

28. *Pleurophyllidia gracilis* B.
29. **Pleuroleura striata* (van Hass.).
30. *Doto indica* B ?
31. *Phidiana unilineata* (A. and H.) ?
32. *Madrella ferruginosa* (A. and H.).
33. *Hermaea minor* B. ?
34. *Cyerce nigra* B.

Of these nos. 2 and 29 (*Doridomorpha* and *Pleuroleura*), both starred, are not from the Maldive or Laccadive Islands.

I have left undescribed eleven specimens which were too much injured to admit of identification. Six were Dorids of soft consistency, without jaws, and with simply hamate teeth: the remaining five were a small species of *Chromodoris*, possibly *scurra*, though, if so, all trace of the characteristic coloration had disappeared.

Though one of the best works ever published on the Nudibranchiata (Alder and Hancock's *Monograph of British Nudibranchiate Mollusca*) is in English, little has been written in our language on the group, and the exotic forms have received scant attention from our naturalists, the greater part of what is known of them being due to the fruitful labours of Prof. Bergh[1].

[1] The reference letters *S. R.* stand for Prof. Bergh's "Malacologische Untersuchungen," published in Semper's *Reisen im Archipel der Philippinen.*

I have therefore given somewhat full descriptions of the family and generic characteristics which I trust will not be considered out of place. In classification I have adopted Bergh's division into Holohepatica and Cladohepatica in preference to Pelseneer's four tribes Tritonioidea, Doridioidea, Aeolidioidea, Elysioidea. There is probably no group of comparatively well-known animals in which we may look forward to as many additions to our knowledge as in the Nudibranchiata, and to the discovery of forms which are not merely new but of morphological and systematic importance. Such are *Doridoxa*, *Atthila* and *Hedyle* discovered in the last few years, and as few seas have been thoroughly investigated and the fauna of many large marine areas (such as the tropical and southern Atlantic) remain as far as Nudibranchs are concerned practically unknown, many more finds may be anticipated. It is therefore better to have as elastic a system as possible, and to arrange the group in a series into which new members can be easily inserted, than to cut it up into rigid subdivisions whose definitions may require alteration. Pelseneer's Tritonioidea contain a somewhat miscellaneous assemblage, and it is not clear what is the distinction between them and the less typical Aeolidioidea. Why, for instance, does *Dendronotus* belong to the former and *Doto* to the latter class? I have, however, departed from Bergh's arrangement in two respects. Firstly, I classify *Tritonia* among the Holohepatica, and not as he does among the Cladohepatica. It is true that its general anatomy allies it rather to the Cladohepatica, but it is clearly a connecting link between the two tribes, and as the distinction between them is the entire or divided condition of the liver, and as the liver of *Tritonia* is entire, it seems more logical to regard it as a holohepatic form with affinities to the Cladohepatica than as a cladohepatic form (which it is not) with affinities to the Holohepatica. Secondly, I have included among the Cladohepatica the Elysioidea or Ascoglossa, which cannot in my opinion be separated from the rest of the Nudibranchiata.

HOLOHEPATICA.

The Nudibranchiata Holohepatica are characterized by the liver being entire and not ramified. They may be divided into two sections, the first containing the Tritoniadae and the second all the other forms. As mentioned, the members of the first section are really intermediate between the Holo- and Cladohepatica: in virtue of their unbranched liver they belong to the former but in their other characters they bear more resemblance to the latter. The other section, often conveniently called Dorids, are characterized by possessing two spermatothecas and a blood gland. Further, in all except a few abnormal genera the branchiae are dorsal and arranged round the vent.

Fam. **Tritoniadae**[1].

The characters of the family may be defined as follows. Animals of moderate or even large size with an elongate and somewhat rectangular body. A frontal veil, usually provided with appendages and two somewhat spoon-shaped tentacles are present. Rhinophores

[1] For the study of this family the following may be consulted. Alder and Hancock, *British Nudibr. Mollusca*, 1855, pt. VII. Vayssière, "Description du *Marionia Berghii*," *Jour. de Conchyl.* 3. S. XIX. 1879. Pelseneer, *Recherches sur divers Opisthobranches*, Bruxelles, 1893, and especially the following papers of Bergh. (1) Semper's *Reisen*, Hefte XV., XVI. and XVII. (2) Nudibr. Mollusca of North Pacific (in Dale's *Results of Exploration of Alaska*). (3) *Beitr. zur Kenntniss der Japanischen Nudibr.* II. (4) *Report on the Nudibranchiata of the Challenger*, 1884. (5) *Opisthobranchier der Sammlung*, Plate. (6) *Nudibranchiate Gasteropoda of the Ingolf Expedition*, 1900.

retractile into sheaths. Branchiae consisting of arborescent tufts set in a single row along the pallial margin. Buccal mass very large; mandibles powerful. Radula wide, with a broad central tooth, the first lateral larger than the rest. Liver not at all ramified. Vent lateral. No blood-gland. One spermatotheca. Reproductive system unarmed.

Setting aside the disputed genus *Hancockia* Gosse, the family may be considered to comprise three genera, *Tritonia* Cuv., *Marionia* Vayssière, and *Atthila* Bergh. Although the creator of the last named considers it sufficiently distinct to form a new family, it has clearly great affinities to *Tritonia*. The characters of the latter genus are as follows. The frontal veil bears papillae and there are two spoon-shaped tentacles. The rhinophores are not laminate but have a single club, surrounded by pinnate filaments. There are no dorsal appendages except the branchiae and no stomach plates. Most authors recognize as a subgenus *Candiella* Gray (*Figures of Moll. Animals*, IV. 1850) distinguished by having only a few digitate processes on the frontal veil and a somewhat narrower radula. The genus *Marionia* Vayssière resembles *Tritonia* externally, but the stomach is armed with a series of horny plates. Generally but not always the appendages on the frontal veil are branched. The genus *Atthila*, instituted by Bergh for a single specimen obtained by the Ingolf expedition in the northern Atlantic, has the frontal veil entire, and rhinophores of the ordinary lamellate type. On the back are three rows of appendages, probably all simple, but the specimen was somewhat damaged. In their general characters the branchiae and buccal parts resemble *Tritonia*.

The Tritoniadae are not numerous in collections, being inhabitants of fairly deep water and only obtainable by dredging, but seem to be cosmopolitan in their distribution. They are recorded from the Mediterranean, the Northern and Arctic Atlantic, Brazil, the Pacific coast of Patagonia, California, the Arctic Pacific, Hawaii, the Cape, the Red Sea, and the Malay Archipelago. *Marionia* is recorded from a less wide range than *Tritonia*, but it is probable that several species described under the name *Tritonia* should really be referred to the latter genus.

The Tritoniadae are sluggish but voracious animals, living largely on Alcyonium, large chunks of which are often found in their stomachs. The spawn is a simple string-like coil deposited on seaweeds or corallines.

The present collection contains only a single representative of the family belonging to the genus *Marionia*, created by Vayssière, and characterized by the presence of a girdle of horny plates set round the stomach.

Marionia Vayssière[1].

1. *Marionia arborescens* B. (*S. R.* Heft XVII. pp. 890—894, Pl. LXXXVIII).

One specimen from Fadifolu Atoll, Maldives, 12—25 *f.* (fathoms). The species was established by Bergh for four specimens captured by Brock at Amboina. The specimen contained in the present collection agrees well with his description but is somewhat smaller, being only 3·5 cm. long and 1·3 broad.

[1] Vayssière, "Sur un nouveau genre de la famille des Tritoniadés," *Comptes rendus de l'ac. des sc.* LXXV. 1877, pp. 299—301. Id. "Description de la *Marionia Berghii*," *Journ. de Conchyl.* 3. S. XIX. 1879, pp. 106—118. Bergh, "Beit. zu einer Monogr. der Gattung Marionia, V." *Mittheil. aus der Zool. Stat. zu Neapel* IV. 2. 1883, pp. 303—326.

The form is as usual in the genus. The colour uniform dirty yellow. From Bergh's specimens it appears that the living animal is yellow with green branchiae. Frontal veil with 10 simple papillae arranged in three groups, four in the middle and three on each side: outside the latter are the tentacles with a deep groove on the under side. The dorsal surface is covered with minute knobs. The dorsal margin is fairly prominent and bears 11 branchiae on each side, of which the first, tenth and eleventh are rudimentary and the fourth, fifth and sixth the largest. The branchiae are long, arborescent and mostly bipinnate. The rhinophore sheaths are distinctly raised and the rim is irregularly scalloped: the rhinophores as usual, with five pectinated filaments and a simple club. The buccal mass, as usual in this family, is enormous for the size of the animal: the jaws are large and strong and the cutting edge bears a single row of large denticles. The radula also as usual, consisting of about fifty rows of yellow teeth: the formula for each row about 45 + 1 + 1 + 1 + 45. The shape of the median tooth and first side tooth as usual: the laterals diminishing towards the outside. The first stomach lamellated: the second with a girdle of yellow horny plates. There are about 30 large plates and numerous small ones of varying sizes between them. The other internal organs were not well preserved, but did not indicate any deviation from the generic characters. The species is characterized by the appendages on the frontal veil being simple and not branched and by the single row of large denticles on the jaw.

Fam. **Doridoxidae.**

This family was created by Bergh in 1900 (*The Danish Ingolf Expedition—Nudibranchiate Gasteropoda*—Copenhagen, 1900) to contain a remarkable mollusc dredged at a depth of 55 *f.* in the North Atlantic. *Doridoxa* is externally similar to the Dorids in its general shape and rhinophores, but has no external gills whatever and the vent is lateral, not dorsal. The jaws are large and strong: the radula is somewhat as in *Tritonia* and *Bathydoris* and consists of a large central tooth with several laterals, of which the innermost differ somewhat in form from the rest. A blood-gland is present and there are two spermatothecas. It is most interesting to find that Mr Gardiner has captured a somewhat similar form at Rotuma in the southern Pacific. The specimen is unfortunately small and the internal organs are hardened into an indistinguishable mass. It is therefore impossible to state whether the animal possesses a blood-gland and a second spermatotheca. If those organs are really absent, it would probably be necessary to make it the type of a new family, but meanwhile its other characters, and in particular the buccal parts, show a close resemblance to *Doridoxa*. It is however in any case generically distinct from that animal, from which it differs in its round form, smooth back, absence of tentacles and its toothed mandibles. A third gill-less Dorid is the *Heterodoris* of Verrill, which has the general shape of *Triopa*, a lateral vent but no mandibles or central tooth. In its external characters it appears to form a good connecting link between *Tritonia* and the Polyceradae, but in its buccal organs it varies from the former family much more than do the Doridoxidae.

2. *Doridomorpha Gardineri* nov. gen., nov. sp.

One specimen from Rotuma. In the tank received by me this animal was concealed within the epipodia of an Aplysia but the position was no doubt accidental and does not indicate any natural association. The form (fig. 1) is oval and much rounder than *Doridoxa*,

the length being 0·65 cm. and the breadth 0·55. Though the back is arched, the height is small compared to the length and breadth, and the general appearance is flat. The colour is a uniform yellowish brown. The back is perfectly smooth and the mantle edge ample all round. The foot (fig. 2) is however not small: in the preserved specimen its edges are turned inwards, but when extended it must be of a considerable breadth. Its anterior margin is not grooved. The visceral mass is much narrower than either the mantle or the foot. The rhinophores (fig. 3) are yellowish and perfoliate: they appear to be retractile into simple holes without any rim, but in the preserved specimen both were exserted. Above the foot and clearly divided from it is a sort of snout without any trace of tentacles. Considering the size of the animal the buccal mass is large and strong. The edge of the powerful mandibles (figs. 4 and 5) is denticulate, and at the base of the denticulations is a row of blunt knobs. The radula (fig. 6) was somewhat injured in extraction but appeared to be short and to contain about 13 teeth in each row. The character of the teeth was, however, clear. The central tooth consists of a basal plate with a strong cusp: the laterals of a basal portion and a hook: towards the ends of the row the teeth grow more slender and elongate and the hook smaller. Owing to the bad preservation of the interior and the small size of the animal it was not possible to satisfactorily determine the character of the digestive tract and other organs, but it was quite plain that the anal papilla was under the mantle and latero-posterior (fig. 2). A careful examination failed to discover a blood-gland, but its absence cannot be regarded as certain. In the central nervous system all that could be clearly made out was that the optic nerve was long and the eyes, which were large and black, situated unusually deep. At the right anterior corner of the foot was situated the large genital papilla with two distinct orifices (fig. 2). It was unfortunately impossible to ascertain the character of the internal genital organs, but the hermaphrodite gland appeared to be large and to cover the liver. There were no signs whatever of internal or external gills.

Fam. **Hexabranchidae.**

The family as at present known is composed of the single genus *Hexabranchus*, with the following characters. Large animals of a flattish shape and with ample and undulated pallial margin. Back soft and smooth. Foot broad. Tentacles foliaceous. Rhinophores perfoliate, retractile. Labial armature very strong. Radula composed of numerous simply hamate laterals, without a central tooth. Branchial apparatus consisting of 6—8 arborescent tufts, separate from one another, not retractile into a common cavity, but each capable of contracting into a small hollow at the base, which does not however amount to a permanent pocket and does not hide the branchia. Anal papilla within the circle of branchial tufts, central or subcentral. Reproductive organs unarmed. Verge exceedingly long. Nervous system much concentrated, so that it is difficult to distinguish the ganglia. Blood-gland single but large. Near the renal pore there is another small orifice of unknown function.

The Hexabranchidae differ remarkably from most Dorids in their habits. They are large, active animals, capable of swimming as well as of crawling. I have generally found them in pools left by the high tide, but think that on these occasions they are merely stranded and naturally prefer deep water. I have also found them swimming on the surface about a quarter of a mile from the coast. Their coloration is generally red and exceedingly conspicuous, in no way resembling their surroundings, but, when at rest, they fold the sides of

the mantle over the back (almost like Placobranchus) and conceal their gorgeous colours, thus entirely altering their appearance. When swimming, they flap the sides of the mantle and bring the two edges of the foot together so as to form a sharp keel. When in captivity I have often observed them adopt an almost vertical position, standing on their heads and walking, or at least feeling their way with their large tentacles. They are very voracious and browse freely on sponges, sertularias, polyzoa, etc.

Bergh has justly observed that it is very difficult to determine the species of *Hexabranchus* without, or even with, an anatomical examination. Perhaps most of the so-called species are merely varieties. Most of them are very imperfectly described, and even in those cases where the description is adequate it is not always plain what are the specific characteristics beyond colour. There are unfortunately no notes as to the colour of the animals in the present collection when living. As preserved they are of an almost uniform dirty yellow. The family is recorded only from the Indo-Pacific (E. Africa, India, Philippines, Polynesia, Red Sea).

The peculiar arrangement of branchiae displayed in this genus is also found in the Bathydorididae and *Kalinga*. The former are deep-sea forms, with strong jaws and a radula provided with a median tooth, and are thus allied to *Doridoxa* and *Tritonia*. The buccal parts of *Hexabranchus*, though unusually powerful, show a near approach to the ordinary type of the cryptobranchiate Dorids. The affinities of *Kalinga* are very uncertain. Bergh places it among the Polyceradae.

Gen. *Hexabranchus*[1] Ehr.

3. *Hexabranchus faustus* B.

I somewhat doubtfully refer to this species a specimen from the S.W. reef of Hulule, Maldives. It is 14 cm. long, and considerably broader across the gills (7·3) than across the head (5·4). The mantle is crinkled at the sides, but quite straight and simple in front. It is compressed against the sides of the body, but the free edge when pulled out and extended measures 2·5 cm. The rhinophore sheaths are slightly raised and quite smooth. The groups of branchiae are set rather close together, and are not always distinct. They appear to be usually 8, but might perhaps be divided differently. Each group consists of several, generally 4, tripinnate tufts[2]. The anal papilla is central, wide, but not very prominent. Near it are the renal pore and the other orifice alluded to. The labial armature and radula are both strong and dark brown, the former consisting of two furrowed plates composed of a compact mass of small and slightly bent rods. The latter contains about 45 rows of simply hamate teeth, there being about 70 teeth on each side of the rhachis in every row. The tentacles are large, foliaceous, furrowed down the middle, and with crinkled edges. Reproductive organs as usual.

4. *Hexabranchus digitatus* n. sp.

One individual from Hulule S. reef, 7·8 cm. long and 5·2 broad, the breadth being much the same in front and behind. The specimen is very much retracted and corrugated

[1] Bergh in *S. R.* Hefte XIII., XVI. and Supp. I. and in *Ergebnisse einer Reise nach d. Pacific*, Schauinsland, *Opisthobranchien*, 1896–7. Several species are described in the voyages of the Bonite, Astrolabe, and the United States Exploring Expedition, vol. XII. (Gould).

[2] Prof. Bergh gives the number of branchiae as 6, but the plate shows 7.

owing to the action of alcohol, but the following characters seem certain and sufficient to establish a new species. The mantle is extremely ample and much crinkled, recalling in this respect *Tridachia*; when extended from the body, the free edge measures 3·4 cms. Over the head are three digitate processes, which are not due to undulations but are distinct and permanent projections from the mantle edge. The rhinophores are not much bent back. The tentacles are almost arborescent; they arise from short stalks, and are deeply indented and subdivided. The buccal parts, nervous system, and reproductive organs are as usual in the genus. The radula and labial armature are strong and reddish-brown in colour. Both the head and the branchiae are withdrawn to an unusual degree into the body. The latter are partly covered by an anterior flap of skin and are crowded together, so that the usual division into groups is not clear. The sections are however divided from one another by eight membranous septa. If this arrangement could be considered with certainty as structural it would afford an interesting link between the ordinary branchial arrangement of *Hexabranchus* and that of the cryptobranchiate Dorids, but in view of the generally wrinkled and contracted state of the specimen I do not think it safe to regard this configuration as more than a distortion, and should define the species by the following characters—mantle edge extremely ample with digitate processes over the head: tentacles much subdivided and almost arborescent. But it must be remembered that specimens of *Hexabranchus* which seem to be mere varieties exhibit great differences in the extent to which the mantle and tentacles are developed.

Fam. **Doridídae phanerobranchiatae.**

A number of Dorids are conveniently grouped together as Phanerobranchiata, that is to say, they have no distinct and permanent dorsal cavity into which the branchiae can be retracted, though when touched the branchiae may contract so strongly as to almost disappear. Bergh divides them into the Goniodorididae, which possess a buccal gizzard (ingluvies buccalis), and the Polyceradae, which do not, an arrangement which brings together forms of such different appearance as *Lamellidoris* and *Ancula*. It seems to me that it would be more natural to subdivide the group into Polyceradae with limaciform bodies, sometimes bearing appendages, and Pseudodorididae, flat Dorid-like forms. It would appear that in other groups closely related genera may either possess or not possess this buccal crop. Thus it is present in *Placobranchus* and *Tridachia*, but absent in *Elysia*. The Pseudodorididae seem to be confined mainly if not entirely to northern seas.

The radula of the Phanerobranchiata is usually narrow and with differentiated teeth. They show a greater variety of form than the Cryptobranchiata, but are far less numerous in species.

Gen. *Notodoris* B.[1]

Body limaciform, with no clear distinction between the back and sides: hard, rough, and rugose; surface filled with spiculae. Frontal veil large. Rhinophores smooth, protected by valves. Gills protected by a large valve, which is sometimes elaborately subdivided. No labial armature. Radula without central tooth but with numerous hamate uniform laterals, having a rudimentary secondary denticle below the main hook.

[1] Bergh, "Neue Nacktschnecken d. Südsee, III." *Journal d. Mus. Godeffroy*, VIII. 1875.

This genus was instituted by Bergh for a single specimen (*N. citrina*) from Rarotonga. I have obtained another (*N. minor*) at Zanzibar, which seems specifically distinct, and the present collection contains a third. All three forms are identical in their anatomy, and are also all of a yellow colour, but they differ externally in the contour of the body and the subdivisions of the branchial valve. It may perhaps be proved that they represent merely varieties or different ages, but provisionally they must be classed as separate species. *N. citrina* appears to have a single median ridge from the rhinophores to the branchiae, a branchial valve with about 8 lobes, and a fairly distinct tail. In *N. minor* the tail is not distinctly marked off from the rest of the body, and the whole animal seen dorsally somewhat resembles *Phyllidia*. The inconspicuous branchial valve is three-lobed, and though the surface of the back is somewhat irregular there are no distinct longitudinal ridges. The colour is lemon-yellow, with black lines, not spots. In *N. gardineri* the long tail is plainly distinguished from the body: there are four dorsal ridges: the branchial valve consists of three lobes, each of which is elaborately subdivided: the colour is yellowish, with a few round black spots.

Notodoris is evidently allied to *Aegirus* (found on the British and E. European coasts) and to the little known *Triopella*, both of which are of hard consistence, and have the branchiae and rhinophores protected by tubercles. This little group of three genera seems to stand near the cryptobranchiate Dorids, inasmuch as the teeth are not differentiated but uniform, and the branchiae capable of being concealed. They are not retractile into a pocket, but the same result is produced by the protecting valve, which shuts down over them. Nothing is known of the habits of these animals. In captivity *N. minor* was quite inert, and did not make any movement. With Mr Gardiner's specimen is a piece of hard, yellow sponge. There is no note, but as the colour and consistency of the sponge closely resemble those of the nudibranch it is highly probable that the latter frequent it.

5. *N. gardineri* n. sp. (fig. 7).

One specimen from Hulule, Maldive Islands. Length 3·35 cm.: breadth at widest part ·9: height at highest part 1·2. Colour, uniform dirty yellow, with a few vivid black spots on the upper but not on the under surface. Frontal veil large and rounded. The flat sole occupies the whole under surface of the body. There is no distinct mantle edge, but a ridge runs from each end of the frontal veil to the branchial valves. Between these are two more ridges, which are again connected by smaller ridges, shaped like the letter Y. The depressions between the ridges are smooth, but the tail and other parts of the body covered with rough and rather large tubercles. The radula (as in the other species) consists of numerous uniform hamate teeth, with a rudimentary additional denticle. Their form is exactly that given in Bergh's plate (*l. c.* Pl. IX. 39). The visceral mass and reproductive organs were too much hardened to admit of any examination, but in *N. minor* the verge appeared to be trifid at the extremity and covered with rows of small tubercles. The rhinophore openings are closed by their valves. The large branchial valve (fig. 8) is composed of three lobes, each elaborately divided and furnished with numerous spatulate processes. In order to preserve the specimen the internal parts were taken out through the foot and the frontal veil and branchial valve not removed. Hence the gills were not examined.

Gen. *Trevelyana* Kelaart[1].

The shape of *Trevelyana* is limaciform, there being no mantle margin or distinction between the back and sides and no appendages. The rhinophores are retractile and perfoliate. The branchiae, which are generally placed about the middle of the back, vary in number (7—32), but are usually numerous, simply pinnate or compound. The tentacles are small. There is no labial armature or rhachidian tooth. The radula is short and narrow: the first and sometimes also the second tooth differs in shape from the others. There are two or three distinct hermaphrodite glands not attached to the liver. The verge is armed.

Trevelyana is only recorded from the Indo-Pacific area, but within it is one of the commonest of polycerids, and is frequent under stones in the littoral zone, *e.g.* in East Africa. It is generally found in pairs.

6. *Tr. crocea* B.

Two specimens from Hulule. Length 2·4 cm.: breadth 1·2. Body rather square and stout: well preserved, but the colour lost, the whole animal being of a uniform greyish-white. Rhinophores small, with about 12 perfoliations, and retractile into simple pits without raised margin. Branchiae 20 in both individuals, forming a circle open behind, which is completed by the anal papilla. The gills are bent inwards, and on their inner side are simple lamellae. The tentacles very small: the radula is composed of about 15 rows: the two teeth next to the rhachis are bicuspid, consisting of a basal portion, from which two hooks arise: the others have a single hook, which is much reduced in the outermost. The nervous system is rather large, and shows the various ganglia very distinctly divided. There are two distinct hermaphrodite glands close together, and not spread over the liver. The verge is armed with small spines. Prostate large.

Though there is no record of the colour of the living animal the specimens seem referable to *Trevelyana crocea* on account of the number of the branchiae and the shape of the teeth.

Gen. *Nembrotha* Bergh[2].

Externally this genus closely resembles *Trevelyana*, and differs only in the gills, which instead of being numerous and small are few in number, but very stout and strong. Internally it differs in the structure of the radula and generative organs. There is a squarish central tooth, with a large hamate lateral at the side. The remaining teeth, which vary in number from 3 to 12, are also generally squarish plates without hooks. The hermaphrodite gland is spread over the liver, and not separated into distinct masses. There is no prostate. As a rule there is no labial armature, but a weak one exists in *N. nigerrima*.

7. *Nembrotha nigerrima* ? variety.

One specimen from Minikoi, much bent and contracted. Length 3·4 cm., breadth 1·6, height 2·4. Colour, a uniform dirty yellow: the gills and rhinophores are much redder, and there are a few raised reddish spots, particularly near the gills. The rhinophores small, with about 30 perfoliations: the skin round the rhinophore openings is much contracted, but no raised edges were discernible. The gills large, 5: two on each side and one in front. As in other species of *Nembrotha* which I have seen the rhachis is very hard and strong, so

[1] A. and H., *Notes on a Coll. of Nudib. made in India*, 1863. Bergh in *S. R.* Hefte XI. and XVI. Id. *Beitr. zur Kenntn. der Japanischen Nudibr.* 1880. Id. *Beitr. zu einer Monographie der Polyceraden*, 1883.

[2] Bergh in *S. R.* Hefte XI., XVII., and in *Harvard Bull. of Comp. Zoology*, 1894.

that when the gills are contracted it almost covers the branchial lamellae, like the valve in *Notodoris*. No tentacles were discernible: the inner lip is brown, and bears a weak armature of small rods: the formula of the radula appears to be $11+1+1+1+11$. The central tooth is squarish: its front edge is turned upwards, and bears four or five denticles. The first lateral is large and sickle-shaped: the rest squarish without hooks, and decreasing in size outwards. Blood-gland large. The hermaphrodite gland spread over the liver. Verge armed with small hooks.

The typical *Nembrotha nigerrima* appears to be black, with bluish-green spots, red gills, and a red mantle border. Several species of *Nembrotha* which I have preserved in spirits have kept their colour well, and I do not think it likely that the ground colour of the present specimen was ever black. I am very doubtful if this individual should be referred to *N. nigerrima*, as both its shape and coloration seem different, but I cannot formulate any separate specific characters.

Fam. **Doridídae cryptobranchiatae.**

The cryptobranchiate Dorids are characterized by the possession of a distinct and permanent dorsal pocket, into which the branchiae can be entirely withdrawn. The rhinophores are invariably perfoliate and retractile. There is never a buccal gizzard. A labial armature is present or absent. The radula is broad, and the teeth either uniform or only slightly differentiated. A central tooth is rare.

In number of species this is the richest family of all the Nudibranchiata. Though cosmopolitan in distribution it is particularly abundant in the Tropics.

Gen. *Chromodoris* A. and H.[1]

The form of this genus is generally high, narrow, and limaciform, the mantle being somewhat small at the sides, but expanding into a fairly ample frontal and caudal veil. The coloration is brilliant. The foot usually projects behind the mantle. The branchiae are simply pinnate, but are sometimes bifid and vary considerably in their arrangement. The tentacles are retractile. The labial disk has a strong armature of minute hooks. The rhachis of the radula is either naked or bears thickenings, very rarely true teeth. The laterals are numerous and hamate: the first is denticulate on both sides, those which succeed it on the external sides only, the outermost at the extremity only.

Chromodoris is the largest genus of the Cryptobranchiatae, comprising over a hundred species. Many of these resemble one another closely in structure, but some show remarkable variations such as *Chr. scabriuscula*, which has a hard tuberculate back and rhachidian teeth, peculiarities which almost entitle it to generic rank. Also the shape is somewhat variable. Typically, it is as described above, but some species are flatter with an ample mantle margin, and present a quite different appearance. Many tropical Chromodorids have considerable powers of altering their form, and alternate between a high narrow condition and a flat condition

[1] Bergh in *S. R.* xi. Supp. Heft i., Hefte xv., xvi., xvii. Bergh, "Neue Nacktschnecken der Südsee," *Journal des Mus. Godeffroy*, Heft viii. 1875 and Heft xiv. 1878. "Untersuchung der *Chr. elegans* u. Villafranca," *Mal. Blätter*, xxxv. 1878. *Challenger Report on Nudibranchiata*, 1884. von Jhering, "Beit. zur Kennt. Nudibr. Mittelmeeres," *Mal. Blätter*, N. F. Bd. ii. 1880. Collingwood, *On some New Nudibr. Mollusca from the Eastern Seas*, 1878.

in which the mantle is extended. *Thorunna*, Bgh., closely resembles *Chromodoris*, but lacks the labial armature.

The Chromodorids are confined to the warmer seas, and are most abundant in the Tropics, but there are some ten species in the Mediterranean, and the genus is represented on the coasts of Japan and California. They are common on coral reefs and in pools filled with seaweed. Their brilliant coloration, which is often dazzlingly gorgeous in the living animal, does not appear to in any way harmonize with their environment. On the other hand some of the most striking species are commonly found under stones where their hues can be neither "protective" nor "warning."

The species of *Chromodoris* are distinguished largely by their colour, though other characters are not wanting, such as the details of the teeth and labial armature, the presence of rhachidian thickenings, glands on the mantle edge, and the arrangement of the gills. The number of gills however is not constant in the same species, and even the arrangement seems to vary. The colour of Nudibranchs as a rule is very variable, but in this genus the general pattern and ground colour, though they may differ in elaboration or intensity, are mostly constant. Unfortunately there are no notes as to the living colours of the specimens in this collection, and in only two are they recognisable, so that it is exceedingly difficult to make any certain identifications.

8. *Chr. elizabethina* Bgh.

Two specimens from S. Nilandu Atoll, Maldives, 30 *f*. One was dissected. The animal was much bent, but if straightened out would have been about 2·5 cm. long by ·6 broad. Colour in alcohol brownish-yellow, margin of mantle whiter. From a black patch between the rhinophores rise three broad black lines, two of which run down the sides and meet behind the gills, while the third runs from the rhinophores to the anterior edge of the branchial pocket. Round the sides of the body are other black lines, in one specimen three, in the other two. In this latter specimen the lines are only on one side, having disappeared on the other. Branchiae twelve, two being free in the middle, and the rest united at their bases into two groups of five, one on each side. Three gills on one side and two on the other were bifid. The radula with thickenings on the rhachis: the innermost teeth with 4 small denticles on each side. The outermost with from 2 to 4 points.

9. *Chr. rosans* B. (? *Chr. Bullockii* Coll.).

One small specimen from Minikoi. 1·3 cm. long and ·5 broad. Colour a uniform reddish-purple, with traces of a white border. Rhinophores and branchiae grey. It would appear that the living animal is rose-coloured, with a brilliant white border and yellow rhinophores and branchiae. Gills nine, apparently set in a horseshoe open behind, decreasing in size as they go backwards. No thickenings or rhachis of radula: teeth as usual, outermost with several largish denticles.

This seems to me to be a young individual of *Chr. rosans* B., which is probably identical with the *Chr. Bullockii* described and figured by Collingwood (*l. c.*).

10. *Chr. pustulans* B.

Two specimens from Minikoi seem referable to this species. Length of largest 2·1 cm., breadth 1·2. The broad back is covered with low, round tubercles. The ground colour is dull yellowish-brown, but the gills and tubercles show traces of bright yellow pigment. The

gills are 12 (eleven in Bergh's specimen), arranged in an incomplete circle, the vacant space in which is filled by the anal papilla. The two median gills are separate, the others connected into two groups, five on each side. A strongish labial armature of bifid hooks. Radula without thickenings or rhachis. Innermost teeth somewhat irregularly denticulate on both sides. Outermost very irregular in shape.

Gen. *Ceratosoma* Ad. and Reeve[1].

This genus is easily recognized by its extraordinary shape. The body rises upwards from the head so that the branchiae are much higher than the rhinophores. Near the branchiae are two side lappets and behind them a long dorsal process. There is a round frontal veil, a narrow mantle edge and a narrow foot prolonged into a tail of nearly the same length as the body. In their essential characters these animals resemble *Chromodoris*[2]. There is a labial armature of hooks: the radula has no central tooth but numerous hamate laterals which are sometimes denticulate. The tentacles are retractile: the branchiae simply pinnate: the reproductive system unarmed, and as in *Chromodoris* there is no true stomach.

I have seen numerous specimens of *Ceratosoma polyomma* alive in East African waters. They are sluggish and generally found among seaweed, where they make no attempt to hide themselves. They have a strong, disagreeable odour. The colour varies from green to chestnut-red and there is also some variety in the shape; one specimen had neither the lateral nor the dorsal lobes.

11. *C. trilobatum* Gray.

Two specimens from S. Nilandu Atoll, Maldives, 30 *f.* The animals as preserved are quite white, except for a slight bluish tinge at the end of the dorsal process. They are hard and of a peculiar waxy appearance. This is not the coloration of the specimens previously described, but the species seems to be really characterized by the back being relatively less steeply inclined than in others, by the thick mantle edge and frontal veil and by the thick, rounded and somewhat indistinct lateral lobes. They resemble fairly well Gray's figure (*Figures of Molluscous Animals*, Pl. 67, fig. 14) of *Doris trilobata*. The largest specimen is 5·7 cm. in length and 1·5 in breadth across the lateral lobes. The strong rounded tail is 3·2 cm. long and the dorsal process 1 cm. The foot is a long narrow groove. The mantle edge, lateral lobes and frontal veil are all thick and indistinctly marked off from the body. The tentacles are retracted: the mouth is a narrow vertical slit between them. The labial armature consists of two light yellow plates, rather soft and composed of little hooks. The radula contains about 70 rows: in each row were numerous hamate teeth bearing a single denticle on each side of the naked rhachis. The back is quite smooth; immediately below the dorsal process lies the small branchial opening, which contracts even further within. The rim is smooth and hardly raised. The branchial apparatus, which is retracted into the lowest depths of the cavity, is rather large and it is a wonder how it can even emerge from so small an opening. The branchiae appear to be 14 in number. In front are two, quite separate. At the sides are six united together and sometimes bifid so that it is hard to say how they should be counted. The posterior ends of these two lateral groups turn inwards.

[1] Bergh, *S. R.* Heft x., xvii., and Supp. Heft i., and in *Nudibranchiata of Challenger*.

[2] Some species of *Chromodoris* (*e.g.* Ch. Semperi) have a dorsal prominence behind the gills which recalls *Ceratosoma*.

12. *C. gracillimum* Semper.

One specimen from Kolumadulu Atoll, Maldives, 33 *f.*, of a uniform dirty yellowish-brown. It is easily distinguished by its very slender dimensions. The length from the head to the tip of the tail is 2·7 cm., the body being somewhat bent. The tail is very long (1·6 cm.) and compressed, being only 2 mm. thick. The breadth across the back is 7 mm., and the height of the dorsal process also 7 mm. The mantle and frontal veil are far more distinct than in the last species and the free mantle edge measures 2 mm. The apertures for the rhinophores and branchiae are very small. The specimen was not dissected.

Two small specimens about a centimetre long from N. Male Atoll, Maldives, 27 *f.*, are perhaps referable to the same species though proportionally less elongate and slender than the larger individual.

Gen. *Discodoris*[1] B.

The Discodorids are soft, flat animals, of an oval or oval-elongate form. The back is granulated or finely tuberculate, and in the known species generally yellow or brown with darker mottlings. The mantle edge is ample but the foot fairly wide, grooved and more or less notched on the upper lip in front. The tentacles are digitiform, the branchial aperture round, crenulate or stellate. There is a labial armature formed of two plates (or a continuous ring) composed of minute rods. The radula consists of simple hamate laterals, without a central tooth. The reproductive organs are unarmed but there are large prostates.

Discodoris is distinguished from *Platydoris* externally by its softer texture and internally by the presence of a labial and the absence of a genital armature. Separate genera have been created by Bergh for several allied forms with a labial armature but showing various peculiarities in the reproductive system.

Discodorids are recorded from the Pacific, Indian Ocean, E. Africa, Philippines, Mediterranean, and West Indies. They are therefore in all probability cosmopolitan. Like *Platydoris* they are frequently found under stones between tides on coral reefs. They are lethargic in their movements and several species have an extraordinary power of self-mutilation. When handled, or apparently when feeling uncomfortable, they slowly detach part of the mantle, or even the whole mantle edge in a complete ring. The remaining part of the animal seems uninjured and lives at least several days. This self-mutilation is generally explained as an attempt to escape from a foe who has seized hold of the mantle, but considering how slowly it is effected and that it takes place when the animal is in captivity and is not attacked, though perhaps suffering from the effects of bad water, it may equally well be regarded as a sign of weakness, due to unfavourable physical conditions[2].

13. *D. concinna* (A. and H.).

One specimen from Minikoi. Length 4·2 cm., breadth 2·2 cm., foot 1·3 cm. wide. The back is minutely tuberculate, yellowish-brown in colour with blackish spots. The tips of

[1] Bergh, *S. R.* Hefte XII., XVI., XVII., Supp. Heft I., and *Challenger Report on Nudibranchs.* Alder and Hancock, *Notes on a Coll. of Nud. Moll. made in India*, 1863.

[2] This self-mutilation is particularly frequent in a species of *Gena* common at Zanzibar. I have collected about 30 specimens and found that they invariably threw off their tail, at least half the bulk of the entire body, within three hours after capture. This was the case when they were put in a vessel quite alone without any other animal or object which could alarm them. The division always took place at exactly the same point, just in front of the last pair of dorsal processes. The rejected half bore an extraordinary resemblance to a nudibranch. The foot was able to adhere and the dorsal processes looked like rhinophores.

the tubercles, both in the yellowish and in the blackish parts, are of a lighter colour than the bases, which gives a curious effect well rendered in Alder and Hancock's plate *l. c.* The foot and under edge of the mantle are spotted with purplish-brown. The rhinophore sheaths are raised and tuberculate. The branchial opening is large and crenulate and contains six tripinnate gills. The labial armature consists of two narrow yellowish plates, which form an almost continuous ring. The radula is as usual in the genus and family broad, the teeth being smaller but not denticulate at the outside.

I think this specimen may be safely referred to A. and H.'s species *concinna*.

14. *D. pardalis*, var. (A. and H.).

One specimen from N. Male Atoll, Maldives, 25 *f.* Length 4·4 cm., breadth 2·1 cm. Dorsal surface finely tuberculate, yellowish, with traces of orange-coloured spots. Under surface yellowish, without spots. Foot grooved at the anterior end but the notch in the upper lamina is hardly perceptible. Branchial opening raised, so as to be almost a papilla, round and not notched. Branchiae six, long and slender, tripinnate. Labial armature circular and very strong, consisting of a compact mass of yellowish rods. Radula unusually narrow: teeth simply hamate, large and coarse and not materially diminishing at the inside or outside of the row. Formula 13 (or 14). O. (14 or) 13. Reproductive system unarmed. Prostates large.

I doubtfully register this specimen as *D. pardalis* (A. and H. *l. c.*) because it has obvious resemblances to that species as described and the points of certain difference do not seem sufficient to constitute a new species. The coloration, the slender branchiae, and the absence or inconspicuousness of the notch on the upper lamina of the foot are all points of resemblance. But the branchial opening though raised is distinctly round and not stellate as in A. and H.'s specimen, and though they give no details as to the radula it is noticeable that they do not allude to its narrowness or the great size of the separate teeth.

15. *D. meta* B.

A single specimen from N. Male Atoll, Maldives, 30 *f.*, seems referable to this species with tolerable certainty. The animal is oval in shape, 2·3 cm. long by 1·7 cm. wide: the texture is soft and the back covered with fairly large papillae. The ground colour is yellowish with the remains of brown and purple blotches in the middle. From between the rhinophores to the gill opening runs a somewhat indistinct dorsal ridge. The mantle margin is ample and undulated. The rhinophore sheaths are projecting, with jagged edges, which in the preserved specimen have closed over the opening. The branchial opening consists of a transverse slit, the upper end of which overhangs the lower. Gills, 6, tripinnate. Foot deeply grooved and notched in front. Labial tentacles reddish-yellow. Labial armature bright blue, formed of minute rods. The radula consists of simply hamate teeth. Both the innermost and outermost, especially the former, are smaller than the median teeth, but none were rudimentary. The cerebral ganglia were rather far apart.

The colour of the labial armature is unusual. In the two specimens examined by Bergh (*l.c.* Heft XII.) it was olive-grey.

Gen. *Platydoris* B.[1]

Flat, oval animals of a fair size and peculiar hard, leathery texture. The back is finely granulated and rough to the touch: the mantle margin ample: the foot grooved in front and the upper lamina deeply notched. The branchial opening is generally stellate: the branchiae are tripinnate and usually five, six or seven in number. There is no labial armature or rhachidian tooth. The radula consists of numerous hamate laterals, the outermost of which are sometimes finely serrulate. The reproductive organs have an armature of hard scales, bearing hooks.

The Platydorids are recorded from the Indian Ocean, E. Africa, the Pacific (including the W. coast of America), the Mediterranean, Great Britain (*Pl. planata*), the West Indies, and the Canaries. They may therefore be considered as cosmopolitan. They are frequent on coral reefs under stones at low tide. They are exceedingly lethargic and are often found wedged into the crevices of stones, the mantle having grown into the shape of the hollow in a way which suggests that the animal has not moved for a considerable period. Several of the species show the same phenomenon of self-mutilation as *Discodoris*.

16. *Pl. eurychlamys* B.

One specimen from the Kolumadulu Atoll, Maldives, 33 *f.* The animal as preserved is 7 cm. long and 4 cm. broad. The back, which is as usual flat and leathery, is blackish-brown, with white spots, which are particularly numerous near the margin. The underside dirty white, with black spots on the foot. The rim of the branchial pocket white; the branchiae six, whitish with black rhachis. The numerous teeth are of the ordinary hamate type; the outermost are very irregular in shape but not serrulate.

From Bergh's descriptions of various specimens the colour appears to be very variable.

17. *Pl. scabra* Q. and G.

One small specimen from Minikoi 3·5 cm. long by 1·7 cm. broad. Not dissected. This species, which I have frequently seen alive in the South Seas, is hard and leathery and grows to be three or four inches long. The mantle is wavy and indented. The labial tentacles small, white and tapering. The rhinophore sheaths somewhat projecting. The colour of the back is white with irregular blotches of brown formed by aggregations of minute spots. The under surface yellowish-white. The branchial aperture has six lobes and presents a star-like appearance. The branchiae are six, yellowish, very voluminous and delicate[2].

18. *Platydoris* sp.

Two specimens from the Maldives, Hedufuri, Mahlos Atoll. The largest is 2·2 cm. long by ·9 cm. broad, the form being somewhat elongate. The back is finely granulated, bluish-white, with traces of yellowish-brown mottlings in the centre. Round the mantle margin

[1] Bergh in *S. R.* Hefte XII., XVI., XVII., and Supp. Heft I., and *Sammlung*, Plate, Opisthobranchiata.

[2] As there seems to be no description of this species except Quoy and Gaimard's brief notes, I add the following particulars taken from specimens examined in East Africa. The living animal is as much as 10 cm. long, very stiff, yellowish-white, with irregular violet mottlings of varying intensity, formed mostly by minute rings of the same colour with yellowish centres or by spots. The under side is a clear yellowish-white, with no markings except at the sides of the foot which are mottled like the back. The branchiae are light yellow with grey axes: the rhinophores, buccal mass and viscera all bright, light yellow. The foot small and narrow, grooved in front and notched, but not deeply: the upper lamina thick. No trace of labial armature. Radula about $48 \times 60.0.60$. Teeth simply hamate: innermost smaller, two or three outermost irregular. Male branch of reproductive organs with the characteristic hook-bearing scales apparently set in four rows: female branch with strong folds.

is a row of purplish spots and the sole and sides of the foot are streaked with the same colour. The margin of the mantle is undulated. The rhinophore sheaths not much raised and with smooth margins. The branchial opening roundish with indistinct lobes and containing five small tripinnate branchiae. No labial armature. The radula consists of simply hamate teeth, smaller towards the outside but not denticulate. The verge is armed with hamiferous discs.

Not having access to the descriptions of some recorded species of *Platydoris*, I cannot give an opinion as to whether this form is new or not. I lay no stress on the branchial opening being roundish. This is not unfrequently the case in alcoholic specimens, although the opening may be typically stellate.

Gen. *Dictyodoris* Bergh[1].

The texture of the body is leathery, the dorsal skin smooth. Foot not grooved in front or only slightly. Branchial aperture round: branchiae few, bipinnate. Tentacles digitiform. No labial armature. Radula of simply hamate teeth with naked rhachis. Reproductive system unarmed. The two known species have reticulate figures on the back and only four branchiae. In *D. tesselata* the outermost teeth are pectinate, in *D. maculata* not.

19. *D. maculata* n. sp.

One specimen from the Fainu-Inguradu Channel, N. Mahlos, Maldive Islands, 26 *f.* Nearly round in form: length 8 mm., breadth 6 mm. Colour bluish-white, with blackish spots which seem to be under the skin. There are several black spots of a more ordinary appearance on the under edge of the mantle and a black rim running round at the junction of the foot and body. On the dorsal surface is a reticulate pattern formed by ridges, but their conspicuousness is due rather to a difference of colour than to their real prominence, which is small. I could not distinguish any groove in the anterior part of the foot. Branchial aperture small and round: 4 bipinnate whitish gills, the posterior pair being smaller than the others: the main and secondary axes are marked by a broad black line. Tentacles digitate: no labial armature: radula fairly broad: no central tooth: laterals simply hamate, the innermost small, the outermost irregular, sometimes bifid or trifid but not consistently pectinate. Central nervous system somewhat concentrated, though not as in *Asteronotus*, two pairs of ganglia being distinguishable.

This specimen bears a striking resemblance to Alder's drawing of *Doris Incii* (reproduced in Gray's *Figures of Molluscous Animals*, 1850, Tab. 226, figs. 1 *a*, *b*, *c*), which, as Bergh points out, may represent either a *Dictyodoris* or *Sphaerodoris*. As however we have no account of the anatomy of this animal, it can never be possible to certainly attribute it to either genus. In spite of the strong external similarity of the present Dorid to Alder's drawing I do not propose to call it *D. Incii* because the figure has (1) indistinct but apparently simply pinnate branchiae, (2) no tentacles, (3) starlike apertures for the rhinophores, (4) no spots or dark rim on the under surface. The genus Dictyodoris appears to be closely related to *Halgerda*, Bergh.

[1] Bergh, *S. R.* Sup. Heft 1. 1880.

Gen. *Staurodoris* Bergh[1].

This genus was established by Bergh for the *Doris verrucosa* which is common in the Mediterranean and is characterized by him as follows. The body is flat and tuberculate: the retractile rhinophores and branchiae are protected by valve-like tubercles. The branchiae are simply pinnate. There is no labial armature or median tooth: the radula consists of numerous simply hamate teeth and the reproductive system is unarmed. If this definition of the genus is rigidly adhered to, the form described below must be made a new genus, as the rhinophores and branchiae are not protected by valves and the branchial opening is crescent-shaped and very peculiar. Von Jhering however describes under the name of *Staurodoris pseudoverrucosa* an animal obtained at Naples in which there were no valves round the gill cavity[2]. It seems therefore simpler to somewhat enlarge the definition of the genus than to create a new one. We may therefore characterize *Staurodoris* as belonging to the large class of Dorids which have no labial armature or median tooth but a simply hamate radula and as distinguished from the other genera by its tuberculate back and simply pinnate branchiae. Perhaps to these characters may be added the shape of the tentacles, which appear as two ridges above the mouth[3].

20. *Staurodoris pecten* nov. sp.

Two specimens from N. Male Atoll, Maldives, 27 *f.* The animals are nearly round, the larger specimen being 1·3 cm. by 1 cm., and flat. The dorsal integument is full of rod-like spicules and studded with small conical warts or papillae, which are not connected or confluent. The colour is quite uniform, in the one specimen yellowish-brown, in the other faded yellow. The foot is broad (1 cm. by 0·7 cm.) and slightly grooved in front, the upper lamina being notched. The rhinophores emerge in the middle of a wart, but can hardly be said to be protected by distinct valves. The gill opening is in the shape of a crescent, the horns pointing anteriorly. The crescent itself acts as one large valve, but its lips are not protected by any special tubercles, and when it is closed and the branchiae completely withdrawn it is hardly distinguishable from the rest of the dorsal surface. The branchiae are disposed in three groups. The anterior one consists of a single simply pinnate leaflet: those to the right and left consist each of six similar leaflets, united at the base so that they might be regarded as bipinnate. The central nervous system is much concentrated and the commissures very short. The tentacles seem to be ridges above the mouth, very slightly grooved externally. There is no labial armature. The radula consists of simply hamate teeth, not denticulate, and uniform except that the innermost and outermost are somewhat smaller than the rest. There is no central tooth. The reproductive system is unarmed.

It is very doubtful whether this species should be regarded as a *Staurodoris* or the type of a new genus. Probably new forms belonging to this group will be discovered and have to be distributed between the genera *Staurodoris* and *Echinodoris*. The latter though strongly characterized externally by its greatly elongate papillae is really closely allied to

[1] Bergh in *S. R.* Heft XIII. Supp. Heft I. and Supp. Heft II. and in *Bull. of Mus. of Comp. Zool. Harvard*, 1894, pp. 160–2. Also von Jhering, *Jahrbücher der Deutschen Malak. Gesellschaft*, 1886, Heft III. pp. 230—233.

[2] It had the further peculiarity of having bipinnate gills.

[3] Since writing the above more than a year ago, I have examined in East Africa several forms referable or allied to *Staurodoris*, which may necessitate a further modification of this definition. I postpone the discussion of their affinities to another paper.

Staurodoris, from which it differs chiefly in its denticulate teeth, penial armature and bipinnate gills. But as seen from the present specimens it is not always easy to say whether gills are simple or bipinnate.

Collingwood (*On some New Species of Nudibranchiate Mollusca from the Eastern Seas*) gives notes on a *Doris pecten* from Formosa. His description is not sufficiently full to decide to what genus the animal should be referred but, as it has a crescent-shaped row of simply pinnate branchiae and the other characters are not inconsistent with those of the present specimens, I have indicated its possible identity in the proposed specific name. No species of *Staurodoris* is recorded with certainty from the Indo-Pacific, but Abraham's *Doris pustulata* seems closely related, though it has bipinnate branchiae.

Gen. *Trippa* Bergh[1].

This genus, which seems identical with *Phlegmodoris* Bergh[2], comprises a few tropical cryptobranchiate Dorids with a soft tuberculous body and no jaws. The characters are as follows. Body flattish, soft, sometimes gelatinous: the dorsal surface covered with tubercles, which are generally compound and support smaller projections. Tentacles small. Foot broadish with a shallow groove in front, the upper part united to the head. The branchial rosette far back at the end of the body composed of five or six tripinnate plumes. No labial armature: radula composed of uniform simply hamate teeth: a number of glandular bodies (? glandulae ptyalinae) are inserted in a circle round the posterior extremity of the oral tube. The reproductive system is unarmed. In the *Opisthobranchier d. Sammlung* Plate (p. 527) Bergh apparently drops the character of the foot being connected with the head.

21. *T. ornata* B.

Recorded hitherto from the Philippines and the Malay Archipelago. The present collection contains two specimens from Mĭnikoi marked "mottled yellowish-brown and white," which agrees fairly well with Brock's coloured sketch of the animal. The preserved specimens are of a purplish grey; the dorsal tubercles somewhat darker, though some on the other hand are quite white. The foot somewhat lighter. They are both about 3·5 cm. long and 2 cm. broad. The back is flattish and covered with numerous small tubercles, which when closely examined are seen to be covered with little lumps. The mantle fairly wide at the sides and over the head, with an irregularly marked dark border. The rhinophores completely retracted, but as far as can be judged bent backwards in the living animal. The branchial orifice set far back, shallow, the branchiae being exposed in both specimens. They are five in number and tripinnate, the secondary pinnae being long and the tertiary short. The anal papilla is central, large and long. The radula is small and white and consists of twenty rows (only one specimen examined), each of which contained from 32 to 37 teeth on each side of the rhachis. The other characters are as for the genus. Except for some small differences in the radula the specimens correspond very well with Bergh's description.

[1] *S. R.* Heft XII. 1877, Heft XVII. 1890, *Opisthobranchier der Samml.*, Plate, p. 527.

[2] *S. R. loc. cit.* Heft XIII. *Bull. of Mus. of Comp. Zool. Harvard*, 1894.

Fam. **Doridopsidae**[1].

The Doridopsidae externally much resemble the cryptobranchiate Dorididae but differ in their internal structure, particularly in the buccal parts. The body is soft, often gelatinous: the back either smooth or covered with soft warts and tubercles. The rhinophores perfoliate and retractile. The branchiae retractile into a common pocket, generally rather large, few in number and tri- or quadripinnate. The foot broad, grooved in front with a notch in the upper lamina, not extending behind the mantle. Tentacles small, not projecting freely and resembling two folds, sometimes hardly distinguishable. The mouth is a fine pore, usually situated in the anterior cleft of the foot: there is no trace of jaws, radula, or labial armature and the buccal organs consist of a slender suctorial tube which can be protruded as a proboscis through the mouth pore. Beneath the anterior part of this tube are two large folliculate glands called ptyaline. The true salivary glands appear to be represented by two nodules at the commencement of the oesophagus. The stomach is surrounded by the liver, which is bifid behind. The nervous system is extremely concentrated. On the interior dorsal wall of the pericardium are a number of folds, sometimes called the pericardial gill, though their respiratory functions are not clear. The hermaphrodite duct is spread over the liver and there are two spermatothecas. There is an armature of minute hooks on the spermatic duct and the glans.

The Doridopsidae are clearly allied to the cryptobranchiate Dorids by their retractile gills and general structure, but can usually be distinguished externally by their soft consistency and pore-like mouth in the anterior pedal groove. The suctorial mouth allies them to the Phyllidiadae, especially *Phyllidiopsis*, and the details of their anatomy (the concentrated nervous system, the pericardial lamellae and the penial armature) present remarkable resemblances to that family. Whether they are phylogenetically more akin to the Dorids or the Phyllidiadae can only be proved, if ever, by the discovery of connecting links, but the present evidence seems to bring them nearer to the former than to the latter group. They differ from the Dorids mainly in the buccal parts, which may be easily modified by diet, but from the Phyllidiadae in their general shape, texture and respiratory organs. The concentrated nervous system and reproductive armature are found in several Dorids and it is not clear that the pericardial lamellae are a character of importance.

The family contains more than 60 species arranged by Bergh in two genera, *Doriopsis* and *Doriopsilla*. The latter, which contain only one certain species, is characterized by the body being hard and by the buccal ganglia being situated at the anterior not the posterior part of the buccal tube. The genus *Doriopsis* (or *Doridopsis*), though apparently not found in the colder seas is probably cosmopolitan in warm waters, being recorded from the Mediterranean, the West Indies, and most parts of the Pacific and Indian Oceans. The animals are generally abundant under stones on coral reefs. Their food is unknown. In captivity I have never seen them take nourishment, though they crawl over stones and sponges as if seeking for something to eat.

[1] Pease, *Proc. Zool. Soc. London*, 1860, *Amer. Journal Conchol.* VI. 1871. Hancock, *On the Anatomy of Doridopsis*, 1865. Alder and Hancock, *Notes on a Coll. of Nud. Moll. from Madras*, 1863. Bergh, "Neue Nacktschnecken der Südsee," *Journal Mus. Godeffroy*, Heft VIII. 1875, Heft XIV. 1878. Id. "Die Doriopsen des Atl. Meeres," *Jahr. der Deutschen Malac. Gesell.* VI. 1879. Id. *Die Doriopsen des Mittelmeeres, ib.* VII. 1880. Id. *Challenger Report on Nudibranchs*, 1884. Id. in *S. R.* Heft X. Supp. Heft I., Heft XV., XVI., XVII. Id. *Die Nudibranchiata holohepatica Porostomata*, Wien, 1892.

22. *D. nigra* Stimpson, var. *nigerrima* B.

Three specimens from the Maldives, Mulaku Atoll 40 *f.*, and Mahlos Atoll 20 *f.* The largest is 1·7 cms. long and ·8 cm. broad. The colour is a deep bluish-black; the foot, especially the margin, is somewhat lighter and on the back are some inconspicuous spots of bluish-grey, looking as if the black pigment had been rubbed off. But there are no signs of white spots, a coloured border or of white on the rhinophores or gills. The latter are six and tripinnate. The internal organs are as usual, but even here the black tint prevails.

This species shows great variety of coloration and in my experience the pure black form is the rarest. At Zanzibar I have found in considerable abundance (1) a black form with large white spots and no border, (2) a purplish form with numerous small spots and a border of the same colour but lighter, (3) a black form with or without white spots and with a bright red border, (4) a greyish-white form without markings; found in the company of (3) and apparently differing only in coloration.

23. *D. apicalis*? B.

One specimen from the Suvadiva Atoll, Maldives, 42 *f.* Length 5·4 cm., breadth across the rhinophores 1·1 cm., across the gills 2·3 cm. The form is thus unusually long and tapering. The back is smooth and the mantle edge narrow. The colour uniform dirty grey with some whitish mottlings on the back but no dark spots or markings. Foot, dirty yellow, smaller before than behind. Rhinophores small, straight with about 20 perfoliations. Gills six, tripinnate. The blood-gland appears to be double and the intestine gives off a small diverticulum near the pylorus. This last character and the elongate tapering shape of the animal incline me to identify it with *D. apicalis* B., recorded from Amboina. But the colour is not quite the same, the shape is not peculiar to this species but found elsewhere (*e.g.* in *D. vidua*) and it remains to be seen whether the diverticulum is a consistent specific character.

Fam. **Phyllidiadae**[1].

The genus *Phyllidia* was created by Cuvier and *Fryeria* by Gray. Our knowledge of the group is however mainly due to the writings of Bergh[1]. The members of the family are perhaps the most easily recognizable of Nudibranchs and can at once be identified by their curious leathery consistency and the brightly coloured lumps or ridges which usually adorn their dorsal surface. They may be more accurately characterized as follows:

The texture of the animals is coriaceous and the form flattish, elongate oval. The margin of the mantle covers the foot all round, though the latter is fairly broad. There is no distinct head but merely a minute oral pore beneath two small digitate tentacles which are united at the base so as to form a rudimentary veil, and are slightly furrowed on the outer side. Seen from above, the shape of the anterior and posterior extremities is much the same. The dorsal surface bears tubercles or ridges, which are generally brightly

[1] Bergh: (1) "Bidr. til en Monogr. af Phyllidierne," *Naturhist. Tidsskr.* 3 R. 1869.

(2) "Neue Nacktsch. der Südsee," *Journal des Mus. Godeffroy*, Heft II. 1873.

(3) Malacol. Untersuch. in *Semper's Reisen*, Heft x. 1876, Heft XVI. 1889 and Heft XVII. 1890.

(4) *Neue Beiträge zur Kenntniss der Phyllidiaden*, Wien, 1876 (aus den *Verhandl. der k. k. zoologisch-botanischen Gesellschaft in Wien besonders abgedruckt*).

(5) *Die Nudibranchiata holohepatica Porostomata*, Wien, 1892 (do. do.).

coloured. The rhinophores are perfoliate and completely retractile. They usually emerge from two of the anterior tubercles. Under the mantle edge are a large number of branchial lamellae which form a more or less complete circuit interrupted only by the mouth and genital orifice and in *Fryeria* by the vent. The mouth parts consist of a minute poriform aperture leading into a narrow tube, which passes into a large mass of glands that impart a thick conical appearance to the anterior portion of the digestive tract (except in *Phyllidiopsis*). Behind this glandular mass the pharynx reemerges as a thin tube, which subsequently dilates and enters the liver. There is no exsertile proboscis as in *Doridopsis*. The vent is usually dorsal and perforates one of the posterior tubercles. Only in *Fryeria* is it under the mantle rim. There are no jaws, radula or buccal armature of any kind. The liver is not divided posteriorly. The verge is armed with rows of hooks. As in the Doridopsidae the dorsal wall of the pericardium is furnished with a series of lamellae, and the nervous system is much concentrated. A single blood-gland is present.

The Phyllidiadae are Dorids in virtue of their unbranched liver, their two spermathecas, their retractile rhinophores, and their usually dorsal vent. The suctorial mouth, the concentrated nervous system and the so-called pericardial gill ally them to the Doridopsidae, but still the group Porostomata proposed for the two families by Bergh seems, as he himself admits, somewhat artificial, for the absence of the ordinary branchial rosette and the position of the branchial lamellae under the pallial margin separate the Phyllidiadae decisively from all Dorids except the Corambidae. From that family however they are equally decisively separated by the structure of the mouth parts and the general habitus.

The family is divided by Bergh into four genera, *Phyllidia*, *Phyllidiella*, *Fryeria* and *Phyllidiopsis*. *Fryeria* is sharply distinguished from the others, the vent not being dorsal but terminal and under the mantle rim. *Phyllidiopsis* is also well characterized, as the mouth parts resemble those of *Doridopsis* and the anterior part of the oral tube is not surrounded by a large glandular mass as in the other genera. The distinction between *Phyllidia* and *Phyllidiella* is less satisfactory. The former is said to have the dorsal tubercles arranged in longitudinal rows and the latter in groups or quincunxes. But there is much variety in respect of this arrangement. I have seen specimens of *Phyllidiella nobilis* in which the tubercles appear to be arranged in rows, and the present collection contains a specimen which has all the characters of *Phyllidia varicosa*, but in which there are only seven tubercles scattered irregularly on the back and certainly not arranged in lines. In dissecting a considerable number of specimens I have not been able to observe the difference noted by Bergh in the mouth parts; in Phyllidia forma tubi oralis glandulâ ptyalinâ obtecti *symmetrica* and in Phyllidiella *asymmetrica*. The remarkable *Phyllidiopsis papilligera*[1], which has elongated papillae on the back, seems worthy to be the type of a new genus.

The Phyllidiadae are abundant in the Red Sea, Indian Ocean, the Philippines and Malay Archipelago, Polynesia and East Africa. They are not recorded from the more northern or southern parts of the Pacific, from the West Coast of America, North or South, from the Mediterranean or Atlantic, except *Phyllidiopsis papilligera* from the Gulf of Mexico. They seem therefore to be tropical forms and so little is known of the Nudibranchs of the equatorial Atlantic that it is probable they will be found there. They appear to be mainly littoral and inhabitants of coral reefs. Hardly anything is known of their manner of life,

[1] Bergh, *Bull. of the Mus. of Comp. Zoology of Harvard College*, XIX. 3. 1890. Since writing the above, I have proposed the genus *Ceratophyllidia* to include this form and another which I have discovered in East Africa.

but from the extreme narrowness of the mouth pore and the oral tube it may be concluded that they live by suction, probably on animal juices. Most authors repeat the statement of Quoy and Gaimard that they are extremely sluggish and almost motionless. I cannot support this from my own observations, as *Phyllidia varicosa* when kept in a basin crept continually round and round as actively as any Dorid. Collingwood (*Nudibranchiate Mollusca from the Eastern Seas*, 1878) describes the spawn as a long irregular narrow ribbon of a whitish colour. When touched the skin of most Phyllidiadae secretes a liquid with a disagreeable smell.

Gen. *Phyllidia* Cuv.

Vent dorsal: tentacles free. Tubercles in centre of back arranged in longitudinal lines: *Phyllidia sensu stricto.* Tubercles in centre of back not arranged in lines but in groups: *Phyllidiella.*

24. *Phyllidia varicosa* Lamarck.

Back with at least three median lines of tubercles, more or less confluent and forming united ridges. Lateral tubercles varying, but generally two or three form an irregular line or ridge running in from the mantle edge to the central dorsal area. Form somewhat elongate; foot broad, darkish in colour, with a distinct black line down the middle. Four specimens from N. Male and Hulule, Maldives.

The colour of this species, as well as the disposition of the tubercles, seem very variable. The living animals, which I have seen at Zanzibar, were of a slaty-blue with brilliant orange tubercles. The specimens preserved in the present collection[1] show three distinct varieties. First, one magnificent specimen from the Maldive Islands, 6 cm. long; the smooth parts of the back are of a brilliant black, the projections lilac, but considerably varying in intensity. The median tubercles are fused into three distinct ridges, not uniting anteriorly or posteriorly, the tubercles appearing merely as peaks on the ridge. Lateral tubercles more or less fused into ridges, but irregular. Secondly, three specimens from the Maldive Islands from 3 to 4 cm. in length. Tubercles and ridges much as in the previous variety: colour black and dirty white, probably representing blue and yellow in life. Thirdly, six specimens from Rotuma with much the same coloration as the last variety. The tubercles are not fused into ridges, but are sometimes quite separate, sometimes connected by a low black elevation. Five of the specimens show a tendency to have the tubercles arranged in seven longitudinal lines, one median and three lateral on each side. In one specimen this arrangement is quite symmetrical and complete. In the others the outer lateral rows are confused and indistinct. The sixth specimen, as already mentioned, is quite abnormal and has merely seven large and indistinctly compound tubercles scattered over the back, though its other characters appear to be those of the species in every respect.

25. *Phyllidia elegans* B.

One specimen from Kolumadulu Atoll, Maldives, 40 *f.* Form elongate, 2 cm. long. Tentacles short and thick. Foot grey, with a thick black line down the centre. The ground colour of the back appears to be black but there are eleven patches of a lighter colour (in the preserved specimen dirty white), two median, one anterior, one posterior, four on the right side and three on the left. They are studded with low confluent tubercles, of

[1] Including six from Rotuma in the South Pacific.

very irregular shape. Those on the median patches are arranged in three not very distinct lines.

Gen. *Fryeria* Gray.

The shape of the animal and arrangement of the tubercles much as in *Phyllidia* but the vent is terminal, beneath the mantle edge, interrupting the branchial circuit.

26. *Fryeria Rüppellii* Bergh.

One specimen from the W. side of Fadifolu Atoll, Maldives, 70 *f.*, 1·5 cm. long. The form and mouth parts are much as in *Ph. varicosa.* There are three longitudinal lines of tubercles on the back, two of which are fused into ridges, while those of the left-hand line are mostly separate from one another. There are also twelve lateral groups of ridges, running inwards from the mantle edge, one anterior, one posterior, and five on each side. The ground colour is blackish, and the tubercles and ridges dirty white, perhaps representing blue and yellow in life. The foot and the rhinophores are yellowish. The animal is undoubtedly a *Fryeria*, and allowing for the variability of markings so common in this family corresponds fairly well with Bergh's description of *Fr. Rüppellii.*

Gen. *Phyllidiopsis* Bergh.

External appearance much as in *Phyllidia* but the tentacles are not free but attached along their entire length. The buccal apparatus resembles that of *Doridopsis,* that is to say it is not involved in a glandular mass. The oral pore gives entrance to a fairly wide chamber with laminated walls, into which opens the anterior portion of the alimentary tube which is cylindrical and receives two small salivary glands. Beneath it is a single gland probably corresponding to the ptyaline gland of other Nudibranchs.

27. *Phyllidiopsis striata*?

One specimen from Haddumati Atoll, Maldives, 40 *f.* Mouth parts as described above. The upper surface of the preserved specimen is blackish, with three white lines down the centre and two white patches one at each extremity. Near the edge are some irregular white markings. There are no tubercles or ridges. The foot and branchiae are somewhat lighter than the back. The form is long and narrow, 1·4 cm. by 5 mm. broad and very flat.

The markings of this specimen do not entirely correspond with Bergh's figure (Semper's *Reisen,* XVI. Plate 84, fig. 23) of an individual captured by Moebius at the Île aux Fouquets, Mauritius, but the differences do not seem sufficient to warrant the creation of a new species.

CLADOHEPATICA.

The Nudibranchiata Cladohepatica are characterized by the liver being ramified or at least divided. The dorsal surface generally bears appendages, into which the ramifications of the liver pass. As a rule, well-developed mandibles and a radula are present. In the more specialized forms the latter is frequently reduced to a single row of teeth. There is no blood-gland and only one spermatotheca.

The numerically largest family of the Cladohepatica, which also shows all the characteristics of the division in a typical form, is that of the Aeolididae, but there are a number

of other families obviously related to *Tritonia*. These mostly show an advance in the direction of the Aeolid type, but do not seem capable of arrangement in a progressive series culminating in *Aeolis*, as most of them have marked peculiarities of their own which are not found in *Aeolis* or other families. Such are the Lomanotidae, Dendronotidae, Scyllaeidae, Bornellidae, Tethymelibidae, Phylliroidae, Hedylidae and Pleurophyllidiadae. The first six of these are not represented in the present collections, which is somewhat remarkable, as *Melibe, Scyllaea* and *Bornella* are all common in the Indo-Pacific.

Fam. **Pleurophyllidiadae.**

These are animals of a remarkable external appearance, which it is easier to recognize than describe. The form is elongate—oval or tongue-shaped. The back is somewhat coriaceous and bounded by a distinct mantle rim which extends beyond the foot. The dorsal surface is marked with longitudinal stripes or tubercles. The head is distinct and divided from the body by a space which may be conveniently called the neck. In front of this neck is a tentacular shield, the corners of which are usually drawn out into points. Behind the neck and immediately under the anterior margin of the mantle are two small perfoliate rhinophores. In front of them are often a wart (caruncula nuchalis) or several papillae. Except in *Pleuroleura* there is a branchial apparatus. Behind the head and underneath the mantle a cleft runs inwards in which are set a number of branchial lamellae, and the sides of the body underneath the mantle edge also bear another series of lamellae. The vent, genital and renal openings are all on the right side. Jaws strong and denticulate. Radula with a strong median tooth, cusped and denticulate. Laterals varying in form, denticulate or not. Liver much ramified, sending branches to the back and sides, which penetrate into the lateral lamellae. On the margin of the mantle are cnidopores, often visible to the naked eye, from which cnidae can be emitted. The reproductive system is unarmed.

The family appears to be cosmopolitan, but is recorded in especial abundance of species from the Indian Ocean. The systematic position of the Pleurophyllidiadae has given rise to some discussion. The older naturalists created a division, Inferobranchiata, to contain this family, the Phyllidiadae and Hypobranchiata (= *Corambe*), but it is now generally admitted that this association of forms is artificial and untenable. The presence of cnidae and the ramification of the liver are points of connection with the Aeolids, and Pelseneer (*Recherches sur divers Opisthobranches*, 1893) actually places the Pleurophyllidiadae among the Aeolidioidea. But their dentition allies them to the Tritonids, and they have distinctive peculiarities which separate them from both Aeolids and Tritonids. No connecting links have yet been discovered which throw light on their relations to other groups.

Gen. *Pleurophyllidia* Meckel[1].

Pleurophyllidia possesses lamellae under the mantle both at the sides and in a cleft. It is distinguished from the other genera which possess them by the following characters.

[1] Bergh, *Bidrag til en Monogr. af Pleurophyllidierne*, 1866. Id. *S. R.* VI. 1874. Id. *Beiträge zur Kenntniss der Japanischen Nudibranchien*, 1880. Id. *Weitere Beit. zur Kenntniss der Pleurophyllidien*, 1890. von Jhering, "Zur Kenntniss der Nudib. der brasilianischen Küste," *Jahrb. d. Malaco. Gesel.* XIII. 1886. Eydoux et Souleyet (under name *Diphyllidia*, *Voyage de la Bonite*, 1841).

The body is elongate. The mantle edge is continuous in front: the rhinophores are placed close together: on the neck in front of the rhinophores is a tubercle (caruncula nuchalis) or a series of papillae. Cnidocysts are present. The genera *Linguella* Blv. (= *Sancara* Bgh.) and *Camarga* Bergh are closely related and are perhaps only subgenera.

About 20 species of *Pleurophyllidia* are recorded from the N. Atlantic, Brazil, Mediterranean, Indian Ocean, E. Africa, Malay Archipelago, Polynesia, and California. They generally inhabit mud or sand and their peculiar shape seems correlated with a burrowing habit. I have observed *Pl. californica* in captivity on the West Coast of N. America. It buried itself in the sand with the head and tail exposed and bent upwards, so that the body assumed a crescent-like shape. A continuous current of water was kept passing from the front backwards under the mantle, the edge of which was apparently applied to the sides so as to form a tube over the lamellae. At night however the animals became very lively and moved rapidly round and round the glass dish in which they were confined.

The species of *Pleurophyllidia* are more distinct than is common among Nudibranchs. A useful synopsis will be found in von Jhering's paper cited above. They may be divided into the species which have tubercles on the back (*Pl. pustulosa* and *marmorata*), and the larger number which have longitudinal stripes. This latter class may again be divided into those which have papillae on the neck and those which have merely one more or less well-developed tubercle before the rhinophores. The several species have usually a characteristic dentition. Another point of difference is that some species have numerous separate lamellae at the sides of the body, while others have these lamellae united into three (or in *Pl. pallida* into only one) continuous bands.

28. *Pl. gracilis* Bgh.

One mutilated specimen from Minikoi seems referable to this species, which was instituted by Bergh for two individuals found at Bombay (*S. R.* VI. p. 250). There was a large rent which had carried away much of the back, most of the left side and nearly all the internal organs. The length is 2·3 cm. but the body was somewhat bent: the breadth ·8 cm. What remained of the dorsal surface was almost colourless, with the remains of numerous yellowish longitudinal bands and occasional traces of brownish pigment. The neck was thickly studded with conical colourless papillae. The gills were fairly numerous and of different sizes. The lamellae on the right side of the body formed three continuous crinkled and sometimes indented lines. The uppermost extended nearly the whole length of the body: the second was shorter, and the third shorter still. The jaws were strong, the cutting edge armed with numerous rows of minute serrulations. The rhachidian tooth of the radula was as usual squarish: there were 7—8 denticles on each side of the central cusp and sometimes two more near its point. The first lateral was also squarish, denticulate on the outer and bearing traces of minute serrulations on the inner edge. The subsequent laterals are denticulate on the outer edge only, and these denticulations decrease as the teeth are further from the centre. The last 10 or 15 teeth are simply hamate and the outermost small and rudimentary.

It is risky to identify a mutilated specimen, but the essential characters of *Pl. gracilis* seem to be (1) numerous nuchal papillae, (2) small outermost teeth, and the present animal possesses both.

Gen. *Pleuroleura* Bgh.[1] (= *Dermatobranchus* van Hasselt).

The genus *Pleuroleura*, which is practically *Pleurophyllidia* without gills or side lamellae, is made by Prof. Bergh the type of a separate family. But as it differs from *Pleurophyllidia* only in the point mentioned and agrees with it in numerous distinctive peculiarities, it seems better to include both in one family, like *Tethys* and *Melibe*, of which *Tethys* has gills while *Melibe* has none[2].

The history of the genus is somewhat remarkable. Van Hasselt described three species of *Dermatobranchus* in 1824. In 1874 Bergh created the genus *Pleuroleura* for a fourth species (*ornata*) and held that there was not sufficient evidence to identify it with *Dermatobranchus* as van Hasselt's specimens were lost. He subsequently discovered them in the Leyden Museum and in 1888 (*l.c.*) expressed the opinion that the identity was practically certain, but maintained the name *Pleuroleura* all the same. By the rule of priority there can be little doubt that the genus should be called *Dermatobranchus*, but that rule is not an end in itself but a means to an end, namely to find one name for one genus or species. When two names have approximately equal claims the earliest ought certainly to be taken. But when hardly anything is known of the animal under the earlier name and practically all our knowledge comes from descriptions published under the later name, it appears to me that the principle at stake is not sufficiently important to outweigh the inconvenience of resuscitating the original designation, a reference to which would give an enquirer very little information.

Pleuroleura strongly resembles *Pleurophyllidia* in appearance, but the known species seem somewhat smaller and have no warts or papillae on the neck. The tentacular shield is perhaps not always so distinct as in the other genus. The rhinophores are set close together, but emerge from separate short sheaths and bear longitudinal folds. The sides of the body bear no appendages, and there are no branchial clefts. The jaws, radula, digestive and reproductive apparatus are all similar to those of *Pleurophyllidia*. The mantle margin is perforated by cnidopores.

Bergh gives as a family character of the Pleuroleuridae, *Notaeum antice in nucham transiens.* If I am right in supposing this to mean that the mantle margin is not continuous in front but interrupted and that the dorsal surface and neck are consequently continuous[3], the character is not possessed by the specimen here examined and apparently not by *Pleuroleura fortunata* (Bergh, *l.c.* 1888, Pl. X. figs. 1 and 3).

Pleuroleura is recorded hitherto only from the Philippines, the Malay Archipelago, East Africa, and Spitzbergen[4]. Nothing whatever is known of its habits.

29. *Pleuroleura striata* (van Hasselt).

Mr Gardiner furnished me with a single specimen found by the Skeat Expedition in Pulau Bidang. It is externally well preserved but very hard and brittle. The form is rather

[1] van Hasselt, *Allg. Konst en letterbode*, 1824, 2. 3. 4. Bergh, *S. R.* VI. p. 276 ff. 1874. Id. "Die Pleuroleuriden," *Zool. Jahrbücher: Abth. für Systematik*, 3 Band, 3 Heft, Jena, 1888.

[2] I have since discovered in East Africa a form which I call *Pleurophyllidiella* and which seems to be a connecting link between *Pleurophyllidia* and *Pleuroleura* inasmuch as it has no branchial clefts but side lamellae only.

[3] This appears to be the case in *Linguella*, v. Bergh, *Anatomisk Undersøgelse af Sancara quadrilateralis*, Plate XIII. figs. 1 and 5.

[4] *Pleuroleura Walteri*, Krause, "Moll. von Ost-Spitzbergen," in *Zool. Jahr.* Jena, 1892, p. 366.

short and broad, 9·5 mm. long, 6 mm. broad across the back: foot 3 mm. broad. The colour of the dorsal surface and of the tentacular shield is blackish. Down the middle of the back runs one fairly straight line. On each side of it are eleven or twelve other lines, not parallel to it, but arising with it at a point behind the rhinophores and going off towards the mantle edge at various angles in a posterior direction. All these lines as well as the borders of the mantle of the tentacular shield are raised, very distinct, and of a whitish-yellow, which contrasts strongly with the ground colour. Numerous cnidopores were distinctly visible on the mantle edge. The anterior corners of the foot are produced. The anterior mantle edge is continuous, but deeply notched above the rhinophores.

The jaws are as usual in the genus, with several (at least six) rows of denticles on the cutting edge. The radula of about 20 fully developed rows. The rhachidian tooth of the usual shape with a long central cusp and about 6 denticles on each side. The first lateral squarish, with about 5 denticles on the outer side. The other laterals were 9—11 in number in the various rows and, as far as I could see, not denticulate. The inner are broad and somewhat clumsily shaped hooks: the outer narrower and of the ordinary hamate type. The intestines were much hardened and little could be made out of them, but the ramifications of the liver seemed discernible.

Van Hasselt's description of his *D. striatus* is as follows[1]. "Corpore nigro, flavo fuscoque variegatissimo: dorso mucoso sulcato, sulcis simplicibus longitudinalibus, rectis parallelis: capitis et pedis margine flavo: tentaculis apice nigris: pallio antice emarginato. Long. pallii 0·011: lat. 0·003. Corporis totius 0·1. Hab. Anjer-baie (Sunda Strait) vulgaris." This description seems applicable to the present animal except that the dorsal stripes are not strictly speaking straight and parallel. A comparison of several specimens might show some variation in this respect, and as van Hasselt says the animal is common they may be found in the future. Meanwhile, I see no reason why this animal should not bear the name *striata*.

Fam. **Dotonidae**[2].

The Dotonidae are closely allied to the Aeolididae in both external and internal structure. The rhinophores however are simple and retractile into wide cup-shaped sheaths. The cerata are arranged in two rows and as a rule are large, ovate, and at least some of them compound. They contain ample and many lobed hepatic ramifications. As a rule there are no anterior tentacles, but a rounded frontal veil. The vent is latero-dorsal. Cnidocysts are absent. The jaws are weak and not denticulate. The radula uniseriate (as a rule): the teeth with a central cusp and more or less distinct lateral denticles. The reproductive system is unarmed.

The Dotonidae as a family are distinguished from the Aeolididae by one character only—the rhinophore sheaths. The genus *Doto* is also marked by its ovate compound cerata and its frontal veil, but a formation of the head analogous to the latter is also found in *Embletonia*, and the nodules on the cerata of *Capellinia* and *Proctonotus* seem a step in the direction of the composite condition. The other genera of the family are less well known and differ from *Doto* chiefly in having some or all of the cerata simple and not compound.

[1] I quote from Bergh's quotation *S. R.* VI. p. 277, not having access here (East Africa) to the original work.

[2] A. and H., *Brit. Nud. Moll.* Trinchese, *Aeolididae del Porto di Genova*, 1881. Vayssière, *Recherches sur les Mollusques Opisthobranches de Marseilles*, 1888. Bergh, *Beitr. z. Kenntniss der Aeolidiaden*, VI. Id. *S. R.* XVI.

The Dotonidae are mostly minute animals and the forms described come chiefly from the northern Atlantic and Mediterranean. At least one species however comes from East Africa, and the family is probably cosmopolitan.

30. *Doto indica* Bgh.?

One small specimen from Minikoi in the Laccadives. Length 7 mm., breadth 3 mm., colour uniform dirty yellow. There were apparently five pairs of cerata on the back, but all have fallen off. One, however, which doubtless belonged to this specimen, was found in the same bottle. It was fusiform and bore three rings of tubercles. The frontal veil was ample and expanded at the side into lappets. The rhinophore sheaths with an uneven indented margin: on the outside of each is an undulated membranous process. The foot rounded in front, the tail short. The jaws weak. The radula uniseriate. The teeth of the form usual in the genus. The central cusp not very prominent, with 3—5 irregular lateral denticulations.

There is, strictly speaking, no proof that this specimen belongs to the genus *Doto*, since the cerata are not preserved, but I think it probable that it is Bergh's *Doto indica* (*S. R.* XVI. p. 795) recorded from Mauritius. The identification is supported by the shape of the rhinophore sheaths and the membranous process.

Fam. **Aeolididae.**

The Aeolids are limaciform animals with tentacles[1], rhinophores either simple or perfoliate but always non-retractile and without sheaths, and simple dorsal cerata containing ramifications of the liver. Mandibles are always present, and the radula has never more than one or three teeth in a row.

The Aeolids are the largest family of the Cladohepatica and comprise about forty genera. It is therefore somewhat remarkable that they should be represented in the present collection by only one small specimen. It has often been noticed that they are far more abundant in Northern than in tropical waters—or at least in collections from the North than in those from the tropics—but still the proportion here is unusually small. My own experience after collecting continuously for a year in East Africa and Zanzibar is that the genera of Aeolids are numerous but the individuals few and hard to get. Dorids can be found under almost every stone on a coral reef, but Aeolids are obtained either in fairly deep water or among seaweed where they are not easily seen.

Gen. *Phidiana* Gray[2].

The characters of the genus are as follows. Body elongate and slender. Rhinophores perfoliate. Foot rounded or truncated in front. The masticatory edge bears a single row of denticles. Radula uniseriate. Verge armed with a hook.

Phidiana is one of the many genera of Aeolididae, which have an elongate body and perfoliate rhinophores. It is separated from most of them by the fact that the anterior

[1] The strange *Pseudovermis Kovalewski* (*Mém. de l'Ac. de S. Pét.* Ser. VIII. vol. XII. no. 4, 1901) is described as having neither tentacles, rhinophores, nor cerata.

[2] A. and H., *Notes on a Coll. of Nudibr. Moll. made in India.* Bergh, *Beitr. z. Kenntniss der Aeolidiaden*, I. and VI. Id. *Opisthobranchier der Sammlung*, Plate.

margin of the foot is round or square and not produced into tentacular prolongations. In its external characters it closely approaches *Speirilla* but differs in the jaws, teeth, and reproductive organs. The genus is recorded from the Indian Ocean and several parts of the Pacific, including the West Coast of South America, and from the Atlantic.

31. *Phidiana unilineata* (A. and H.)?

One small specimen from Fadifolu Atoll, Maldives, 25 *f.*, imperfectly preserved. Length 9 mm., breadth 2·5 mm. Colour uniform yellowish-white. Cerata partly lost, but apparently arranged in seven indistinct oblique rows, leaving only a narrow space bare in the middle of the back. Foot rounded in front. Tentacles long: rhinophores much shorter. Jaws long and narrow, with a single row of rather distinct denticles. The radula consisting of about 25 teeth, bearing from 5 to 8 lateral denticles, two or three of which are not on the basal portion but on the sides of the cusp itself. The penial hook was small but appeared to be shaped as in Bergh's figures of *Ph. selencae.*

This specimen perhaps belongs to A. and H.'s *Ph. unilineata* (*l.c.*) in view of the habitat and of the fact that there is nothing in its external or internal characters which conflicts with the identification. Still, the anatomical details given by A. and H. do not afford many specific characters, and all trace of the colour has disappeared in this specimen. It is therefore impossible to be sure of the identification.

Fam. **Janidae** Bgh.[1]

The Janidae closely resemble the true Aeolids, but are distinguished externally by the cerata extending not only all round the sides and end of the back as usual but also in front of the rhinophores along the anterior mantle margin. This character is accompanied by a corresponding arrangement of the hepatic ramifications which supply the cerata. Further, in most members of the family the radula is multiseriate; there is a crest between the rhinophores (except in *Proctonotus*) and the vent is median and dorsal. The genus represented in the present collection, *Madrella*, does not possess these peculiarities and serves to connect such forms as *Janus* and *Proctonotus* with the ordinary Aeolids. The radula has only three teeth in a row, and the vent is lateral, not dorsal. In all the known genera the reproductive system is unarmed and there are no cnidocysts.

Gen. *Madrella* A. and H.

32. *Madrella ferruginosa* A. and H.

One small and immature specimen obtained off a large *Antedon laevissima* from S. Nilandu Atoll, Maldives, 30 *f.* Length 6 mm., breadth 4 mm. The animal is oval and flat, of a deep copper colour. Round the dorsal margin is set a not very thick band of cerata and on the central area of the notaeum are a few scattered papillae. Both the mantle edge and the foot are wide, but between them there is a deep groove. The vent is at the posterior and the generative opening at the anterior end of the right side. The form of the rhinophores is unusual: they are not perfoliate, but there is a circle of papillae

[1] A. and H., *Monograph of Brit. Nud. Moll.* Id. *Notice of a Coll. of Nud. Moll. made in India.* Bergh, *Beiträge z. Kennt. d. Aeolidiaden*, I. 1873. Id. *Report on Challenger Nud.* Trinchese, *Aeolididae del porto di Genova*, 1881.

round the club much as in *Tritonia*. The mantle overhangs the head: there are no anterior tentacles, but the head is broad and crescent-shaped with produced ends. The mouth is ventral: the front of the foot square, without tentacular prolongations. The jaws are large and not denticulate. The middle tooth of the radula has a central cusp with 7—8 denticles on either side, and the laterals are denticulate on the inner margin. The ganglia of the central nervous system are distinct.

This genus is recorded from the Indian Ocean (A. and H.) and Zanzibar, where I have captured many specimens. The external characters of the animal vary somewhat with the size, that is presumably with age. The smaller specimens are as described above. The larger have many more cerata, and the papillae in the centre of the back (which apparently do not contain hepatic ramifications) pass up between the rhinophores, forming a sort of rudimentary crest. They have also a white patch between the rhinophores, which is absent in the smaller individuals. When kept in captivity *Madrella* pours forth a peculiar ferruginous secretion, which discolours the water round. It appears to proceed from the whole surface of the body, not from any one gland, and is of much the same colour as the skin, so that the creature looks as if it were dissolving.

There are four more families of the Cladohepatica which are sometimes classed together as the tribe Elysioidea (Pelseneer) and sometimes united with *Oxynoe* and *Lobiger* as the Ascoglossa (Bergh) or Saccoglossa (v. Jhering). They are (1) Hermaeidae, much like Aeolids externally but without oral tentacles. (2) Phyllobranchidae, with peculiar flat leaf-like cerata. (3) Elysiadae (including *Placobranchus*), with no cerata, but lateral expansions or wings. (4) Limapontiadae, small forms with no cerata, wings or appendages, and often with neither tentacles nor rhinophores. All these families have a ramified liver and also the following anatomical characters. (1) There are no jaws. The radula consists of a single series of teeth, each fitting into the next. The front teeth instead of becoming worn away and destroyed fall into a peculiar pouch in which they are preserved. This form of radula may be conveniently termed "ascoglossan." (2) In the nervous system the cerebral and pleural ganglia are fused, the pedal ganglia are approximated and the visceral commissure bears three ganglia (but in *Limapontia* only two). (3) The reproductive organs, though imperfectly understood, are extremely complicated, provided with accessory glands and ramified throughout the body. The male and female orifices are far apart, and there are generally two of the latter.

Fam. **Hermaeidae**[1].

The Hermaeidae closely resemble Aeolids and can hardly be distinguished by any external character except that the oral tentacles are not developed. *Stiliger Mariae* was described by its discoverers, Meyer and Möbius, as an *Embletonia*. Internally, the family is distinguished from the Aeolids by the following characters: (1) Jaws are absent and the radula is ascoglossan, (2) the nervous system is formed of seven ganglia, (3) the hepatic system is somewhat as in *Fiona*, there being no posterior hepatic trunk: the lateral branches are often much ramified in the cerata and dorsal integuments. The vent as a rule is dorsal and anterior. (4) The genital apparatus is much complicated by the presence of accessory

[1] Alder and Hancock, *Brit. Nudibr. Mollusca*. Bergh, *Beitr. zur Kennt. der Aeolidiaden*, IV., V. and VIII. Id. *S. R.* Heft XVI. Vayssière, *Recherches sur les Moll. Opisth. du Golfe de Marseille*, 1888. Pelseneer, *Recherches sur divers Opisthobranches*, 1893.

glands, which are often diffused and ramified throughout the body. But the details of structure seem to vary in the different genera and even species.

Gen. *Hermaea* Lov.

Small animals resembling Aeolids in shape but without oral tentacles. Foot long and narrow with round expanded anterior corners. Rhinophores canaliculate. Cerata elongate or slightly fusiform, arranged somewhat irregularly at the sides of the back. Hepatic trunks elaborately ramified in the cerata and dorsal integuments. Anal papilla large, medio-dorsal. Genital orifices distinct, at base of rhinophores. Albumen-gland diffused and in some species at least ramified in cerata. Verge generally armed with a spine[1].

33. *Hermaea? minor* B.

One specimen from the Laccadives, Minikoi. Length 3 mm.: breadth 4 mm. On the label is written "Green nudibranch": the preserved specimen is of the usual dirty yellow. The centre of the back bears no cerata, but on the sides are about 20 rows containing 2 to 4 papillae each. The cerata are elongate, fusiform, and besides the hepatic ramifications contain other glands, the openings of which form tubercles on the exterior surface. The teeth appeared to be 11 in all, exclusive of those in the bag, transparent, and very narrow. I could not discover more than two genital openings, and there appears to be no hook or spine on the verge.

I think this specimen probably belongs to a species which I have found abundantly at Zanzibar, and which is perhaps identical with Bergh's *H. minor* from Mauritius. The colour does not quite correspond with the descriptions of Bergh's two specimens, which are said to have had the cerata tipped with red. My specimens varied from brown to white, and in captivity tended to assume the latter colour. The prevailing tint of the newly-captured animals was however green, the body walls being pale translucent green, and the hepatic ramifications dark bright green. The eyes were distinct on a yellow spot. The cerata were not tipped with red, but some specimens had splashes of carmine on the back. I append a drawing made from life by Mr Crossland (fig. 9).

It is possible that these specimens may after all not be identical with *H. minor*, for they had never more than 4 cerata in a row, whereas the latter is said to have as many as 10.

Fam. **Phyllobranchidae**[2].

The animals belonging to this family can easily be recognised by their flat shape and leaf-like cerata.

There is a small frontal veil, above which rise two bifid canaliculate rhinophores. Small canaliculate oval tentacles are generally present. The sides of the back are covered with thick rows of large, flat, leaf-like cerata, which generally, if not always, contain hepatic diverticula. Anal papilla large, dorsal, or lateral. No cnidocysts. Genital apertures two: ♂ on

[1] The genus has been subdivided as follows: (1) *Hermaea* sens. stric. Teeth smooth, liver ramified within cerata: vent median dorsal. (2) *Hermaeina* Trin. Teeth denticulate on lower edge. (3) *Placida* Trin. Hepatic lobes not ramified within cerata. (4) *Hermaeopsis* A. da Costa. Vent lateral. Pelseneer has also pointed out remarkable differences between *Hermaea dendritica* and *Hermaea bifida*.

[2] A. and H., *Notes on a Coll. of Nud. Moll. made in India.* Bergh, *S. R.* II., XVI. *Beitr. zur Kennt. der Aeolid.* IV. Pelseneer, *Recherches sur divers Opisthobranches*, p. 51.

right side of head and ♀ behind it. No jaws: a gizzard attached to the buccal mass: radula ascoglossan: teeth generally denticulate: only a very few functional at a time. Genital apparatus exceedingly complicated.

There are three genera (1) *Phyllobranchus* A. and H. Foot undivided: teeth denticulate, forming a spiral in the radula bag. Gizzard long. Vent lateral. Verge unarmed. Recorded from the tropical parts of the Pacific and Indian Ocean and from the Caribbean Sea. (2) *Cyerce* B. Foot transversely divided: teeth denticulate, forming an irregular heap in bag. Gizzard short. Vent dorsal. Verge armed. Recorded from the tropical Pacific and Indian Ocean. (3) *Caliphylla* Da Costa. Foot undivided: no oral denticles: teeth not denticulate, forming a spiral in the bag. Vent latero-dorsal. Verge unarmed. Two species from the Mediterranean. It is possible that there may be really a fourth genus, since A. and H. describe their *Ph. orientalis* as having cerata round the head, apparently like Janus. Bergh thinks this is merely a mistake.

The present collection contains two specimens referable to *Cyerce*. There is some doubt as to the relations of the cerata, and the liver in this genus. Pelseneer (*l. c.* speaking of *Cyerce Jheringi*, of which I have not seen a detailed description) states that the liver is entirely contained in the visceral mass, and does not extend into the cerata. Bergh (1871) seems satisfied that the papillae do contain hepatic ramifications, though he admits that the structure of the liver is obscure, and that the "hyaline folliculi" in the cerata can only doubtfully be homologised with the contents of the cerata of *Phyllobranchus*. The present specimens throw no light on the matter.

34. *Cyerce nigra* B.

Two specimens from Minikoi, which had entirely lost their cerata, only one small detached leaflet being found with them. Apart from this the animals were well preserved externally, but the internal organs were hardened into a uniform mass, in which nothing could be distinguished. What remained of the colour was black with reddish-yellow spots, and lines consisting of a border round the foot, another round the mantle edge, and two lines behind the moderately large pericardial prominence. The body was very plump. The length of the largest specimen 2·1 cm., the breadth 1 cm., the height 9 mm. The oval tentacles small, canaliculate and continuous with the ends of the moderately-large frontal veil, from which a sort of ridge runs down to the anterior margin of the foot. The foot is broad, and very deeply grooved in front. The transverse division of the under surface is quite distinct, but not very deep. The part of the foot before the division is 5 mm. long. The anal papilla in front of the pericardium large and high. The rhinophores strong, bifid and canaliculate. Of the internal organs nothing could be ascertained except that the teeth are long and denticulate. The single small detached papilla, which was preserved, was black, with a reddish-yellow margin and spots of the same colour on both sides. It may therefore be concluded that at least one and probably both the specimens belonged to the variety *ocellata* B.

This collection of Nudibranchs does not in any way indicate that the fauna of the Maldive and Laccadive Islands contains any element foreign to the rest of the Indo-Pacific. All the genera except the very doubtful *Staurodoris* are typical of this area, and all the species, which are not new, are more or less certainly recorded from it. Two points however are worthy of notice. Firstly, a large number of common and characteristic Indo-Pacific

Fig 1.

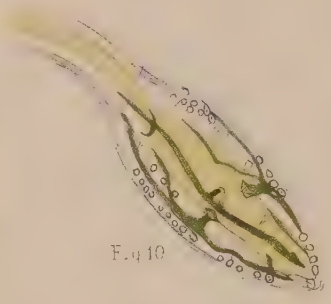


Fig 10

Fig 4

Fig 3

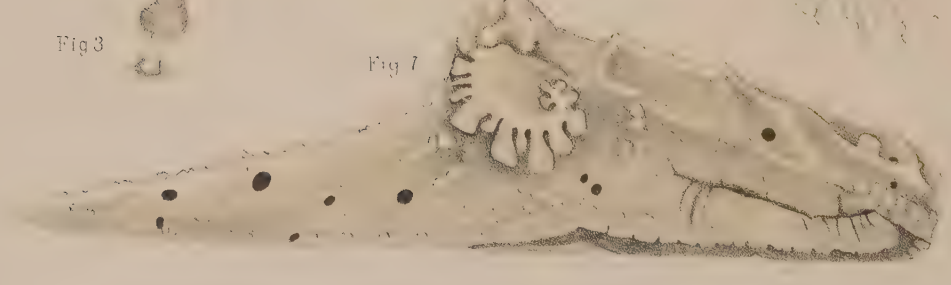
Fig 5

Fig 2

Fig 8.

Fig 3

Fig 7



E. Wilson, Cambridge.

Nudibranchiata

genera are absent, such as *Asteronotus*, *Kentrodoris*, *Casella*, *Melibe*, *Bornella*, and *Placobranchus*[1], and secondly, the specimens are on an average considerably smaller than those recorded from the Philippines, India, or East Africa. This latter feature is also noticeable in the Tectibranchs (particularly the Pleurobranchoids) collected by Mr Gardiner, and I have observed it in the specimens collected by myself at Samoa. It would seem as if the marine fauna of small islands which have never been connected with a continent is less both in number and size than that of the mainland and its adjacent islands. I am not however sure that a thorough examination of the Polynesian fauna would bear out this conclusion, particularly as regards the number of genera and species.

EXPLANATION OF PLATE XXXII.

Doridomorpha gardineri nov. gen., nov. sp.

1. Dorsal view of a preserved specimen. 2. Ventral view of the same. 3. Rhinophore pulled out of its pocket after removal of mantle. 4. Mandible. 5. Edge of mandible more highly magnified. 6. Teeth (*a*) central, (*b*) first lateral, (*c*) from centre of row, and (*d*) outermost.

Notodoris gardineri nov. sp.

7. Animal preserved in spirit about twice the natural size. 8. One lobe of the branchial valve.

Hermaea minor Bergh.

9. Living animal. × 10. 10. One of the cerata. × 30.

[1] These genera are recorded from the Philippines, Indian Archipelago, and South Seas, and I have found them all abundantly on the East Coast of Africa.

MARINE CRUSTACEANS.

IX. THE SPONGE-CRABS (DROMIACEA).

By L. A. Borradaile, M.A., *Lecturer in Natural Sciences at Selwyn College, Cambridge.*

(With Plate XXXIII.)

The members of the Dromiacea are separated from the other groups of Brachyura by a number of characters, most of which are primitive and show that they are nearer than the rest of the Crabs to the macrurous ancestors from which the tribe arose. The most important of these features are: the presence of a pair of vestigial limbs on the first abdominal segment of the female, and often on the sixth in both sexes[1], the epipodites, which are often found on one or more of the pairs of legs, the number of gills, which is usually large, the more or less square shape of the mouth, the large, usually free, basal joint of the antennal stalk, and the often incomplete orbits. To these must be added a highly characteristic, but not primitive, feature—the small size, dorsal position, and usually prehensile shape of one or both of the hinder pairs of legs (Pl. XXXIII).

This conformation of the hinder legs is connected with the most characteristic peculiarity in the habits of the Dromiacea. Most of them are in the habit of holding over their backs masses of some sessile animal—usually a sponge, but at times an ascidian, an alcyonarian, or even half a bivalve shell, on which a sea-anemone is often seated—by means of which they are completely hidden[2].

The most important part of the prehensile apparatus by which this is accomplished is the last joint of the legs of the hinder two pairs. This joint is sharp and hooked in most genera, and is buried deeply in the substance of the sponge. There is often also a thorn on the propodite, which makes with the last joint a more or less perfect chela (Pl. XXXIII, figs. 3 *b*, 4 *b*). In many cases, at least, the crab does not confine its choice to one species of sponge. Whether the latter is at first merely a fragment broken off from a larger mass, or is always a whole colony, perhaps specially adapted to this life and not found elsewhere, is not known, but in any case the initiative in forming the partnership must come from

[1] Bouvier (*Bull. Soc. Philomath.* Paris, 1896) throws doubt on the correctness of the view which homologises the structures on this segment in Dromiidae with the last pair of limbs of Macrura.

[2] This curious habit is also found in the Dorippidae among the Oxystomata (see above, p. 435, vol. 1.).

the crab, for the sponge is quite free, and is merely held in position by its host. On the other hand, it must live thus for some time, and grow meanwhile, for it will always be found to have a deep hollow on the underside, closely fitting the back of the crab. No doubt this helps to keep it from slipping, as does also, perhaps, the hairy or woolly coat with which the decapod is usually provided. The hairs of this coat are often very diverse and complicated in shape—pointed or clubbed, feathered or simple (Pl. XXXIII, figs. 1 *b*—*d*, 3*c*—*f*[1])—though it is hard to see what end these can serve.

Of the two groups into which the Dromiacea are subdivided, the Homolidea are principally deep-water forms, and were not met with by the expedition. The Dromiidea, on the other hand, are fairly common on the reef, where they are to be found in all possible positions, holding on tightly with the sharp tips of their very mobile walking-legs (Pl. XXXIII). In their habits they are slow and heavy, trusting rather to concealment than to active avoidance and defence.

In the systematy of the Dromiidea much use is made of the *sternal grooves* of the female. These are a pair of furrows, one on each side, which run longitudinally over the thoracic sternites of the female, beginning on the hindermost and ending on that which corresponds to the first, second, or third pair of legs. Their forward ends may be raised on knobs, and are either wide apart, side by side but not meeting, or curving round to meet. They correspond closely with the position in which the long abdominal limbs of the male are carried, and are therefore probably used for some sexual purpose. Other features of systematic importance in this group are: the presence or absence of epipodites, the proportions of the body and the extent to which furrows are present on the back, dividing it into regions, the shape and relative length of the legs, etc. For specific distinctions, the shape, number and arrangement of the teeth on the front, anterolateral edge, underside of the body, and legs are chiefly used.

The following keys, introduced here in performance of the promise given in the article on the classification of the crabs (p. 426 above), will enable members of the legions and families of the Dromiacea to be recognised:

Key to the legions of the Dromiacea.

I. Sternum of female with longitudinal grooves. Vestiges of 6th pair of abdominal limbs usually present. Gills 14—20 on each side. Eyes usually completely sheltered by orbits when retracted. No *lineae anomuricae*. *Dromiidea.*

II. Sternum of female without longitudinal grooves. No vestiges of 6th pair of abdominal limbs. Gills 8—14 on each side. Eyes incompletely or not at all sheltered by orbits when withdrawn against the body. *Lineae anomuricae* usually present. *Homolidea.*

Key to the families of the Dromiidea.

I. No vestige of 6th abdominal limb. Carapace longer than broad, with ill-marked side edge. [First three legs with epipodites, fourth and fifth small, subdorsal, and prehensile.] *Homolodromiidae.*

[1] For the investigation of this interesting point I am indebted to Mr Edwin Wilson's enthusiasm for the subject.

II. A vestige of the 6th abdominal limb present [except in *Hypoconcha*, where also no epipodites]. Carapace usually not longer than broad, with well-marked side edge.

A. An epipodite on the first leg (cheliped) only or on none. Fourth and fifth legs small, subdorsal, and usually prehensile. *Dromiidae.*

B. Epipodites on all the first three pairs of legs. Fifth leg only small and subdorsal. *Dynomenidae.*

Key to the families of the Homolidea.

I. Gills 13 or 14 on each side. Epipodites on first one or three pairs of legs. First joint of eyestalk not much longer than second. *Homolidae.*

II. Gills 8 on each side. Epipodites not found on any legs. First joint of eyestalk much longer than second. *Latreillidae.*

Of the seven species in the present collection three are new, and all the remainder are already recorded from the Indian region. Many of the specimens bear sponges, but, as the species of these have not been determined, no further allusion will be made to them.

Family **Dromiidae.**

Generic names in this family are used here in the sense in which they have lately been defined by the writer (*Ann. Mag. Nat. Hist.* (7) XI. p. 298).

Genus *Dromia* Fabr., 1798.

1. *Dromia rumphi* Fabr., 1798 (Pl. XXXIII, fig. 1). Alcock, v. p. 137.

In young specimens, such as the one figured on Pl. XXXIII, there is a distinct tooth at the inner orbital angle, and the teeth on the wrist are also much sharper. The species was dredged in Haddumati Atoll in 40 fathoms.

Genus *Dromidiopsis* Borradaile, 1900.

2. *Dromidiopsis australiensis* (Hasw.), 1882.

Dromia (*Dromidia*) *australiensis*, Alcock, *Cat. Ind. Decap. Crust. Ind. Mus.* I. i. p. 76 (1901).

Var. *bidens* n. Specimens of the variety described by de Man [*Zool. Jahrb. Syst.* IX. p. 372], with only *two* of the three teeth behind the orbital angle in the type, were taken in the Maldives. I propose to name this variety *bidens*. A specimen from Fiji in the Cambridge Museum belongs to the same variety, but there is another Rotuman specimen, and one from Fiji, which have only *one* of the three side teeth remaining. This I propose to call var. *unidens*.

Taken on the reef at Hulule, Male Atoll, and dredged in 25 fathoms in South Nilandu Atoll.

3. *Dromidiopsis tridentatus* n. sp. (Pl. XXXIII, fig. 2).

Diagnosis: "A *Dromidiopsis* whose carapace is slightly longer than broad; the body and limbs smooth, covered with a fine down; the front triangular with the tip just visible from above, deeply grooved and with low swellings of the sides to form a pair of indistinct teeth; no trace of a tooth at the upper, inner orbital angle, the outer orbital angle strong,

but not forming a tooth, a deep cleft on the orbital edge just below the outer orbital angle; three small blunt knobs on the anterolateral edge behind the outer orbital angle, two broad notches behind these teeth corresponding to the branchial groove (which is present) and probably to the cervical groove (which is absent); the 2nd and 3rd legs with strong, hooked end-joints, armed with a few thorns underneath, the fourth leg short, subchelate, and the fifth leg as long as the third, also subchelate."

Length: 11 mm. Breadth: 10 mm. Colour in spirit: pale yellow.

One female from Hulule, Male Atoll.

This species much resembles *Dromidiopsis australiensis*, but may be distinguished by the more distant and more outstanding teeth of the anterolateral edge, which in *D. australiensis* are broader at their base, by the sternal grooves of the female, which meet and end on the segment of the first walking-leg, and by the presence of a spine on the *hinder* edge of the propodite of the fifth leg. The cheliped has an epipodite.

Genus *Dromides* Borradaile, 1903.

For a diagnosis of this genus see the paper cited on p. 576 above.

4. *Dromides hilgendorfi* (de Man), 1887. Alcock, v. p. 145[1].

Dredged in Suvadiva and South Nilandu Atolls, in 30 and 19 fathoms respectively.

Genus *Cryptodromia* Stimps., 1858.

5. *Cryptodromia bullifera* Alc., 1898. Alcock, v. p. 143.

Dredged in South Nilandu Atoll in 30 fathoms.

6. *Cryptodromia hirsuta* n. sp. (Pl. XXXIII, fig. 3).

Diagnosis: "A *Cryptodromia* with the body broader than long, smooth and hairy, the regions indistinct; the front prominent and bearing three fairly sharp teeth, of which the middle one is somewhat longer than those at the sides; the upper rim of the orbit finely beaded and bearing a tooth near its inner end, a tooth at the outer and another at the lower inner orbital angle; one tooth on the anterolateral edge and a low swelling behind this tooth, a small blunt tooth behind the branchial groove, and a strong conical subhepatic tooth; the carpopodite and propodite of the cheliped and second two pairs of legs knobbed, but without sharp thorns, and the last two pairs of legs short, subequal, and feebly chelate."

Length: 7 mm. Breadth: 8 mm. Colour in spirit: dull yellow, legs often orange.

The sternal grooves of the female end widely apart on the line between the sternites of the first and second walking-legs. There is no epipodite on the cheliped.

Taken on the reef in Minikoi and Male Atolls.

[1] For the principle on which references are given in this series of papers see above, Pt. I. p. 192. Alcock's paper on Indian Dromiacea here referred to appeared in *Journ. As. Soc. Bengal*, LXVIII. ii. (1899).

Genus *Cryptodromiopsis* Borradaile, 1903.

For a diagnosis of this genus see the paper cited on p. 576 above.

7. *Cryptodromiopsis tridens* n. sp. (Pl. XXXIII, fig. 4).

Diagnosis: "A *Cryptodromiopsis* with the body broader than long, smooth and hairy, the grooves between the regions almost wholly lost, a smooth, naked, oval boss on each side of the cardiac region; the three teeth of the front of almost equal length and all sharp; teeth at the upper and lower inner, and at the outer orbital angles; two anterolateral teeth but no tooth at the branchial groove; a subhepatic tooth and a prominent angle of the mouth; the fingers of the chelipeds gaping and two blunt teeth on the wrist; a thorn at the end of the carpopodite in the first two pairs of walking-legs, and another at the end of the propodite in the last two pairs, making with the end-joint a strong chela."

Length: 6 mm. Breadth: 8 mm. Colour in spirit: dull yellow.

There is no epipodite on the cheliped, and the sternal grooves of the female end side by side on the cheliped segment without actually meeting.

Taken on the reef in Male and Minikoi Atolls.

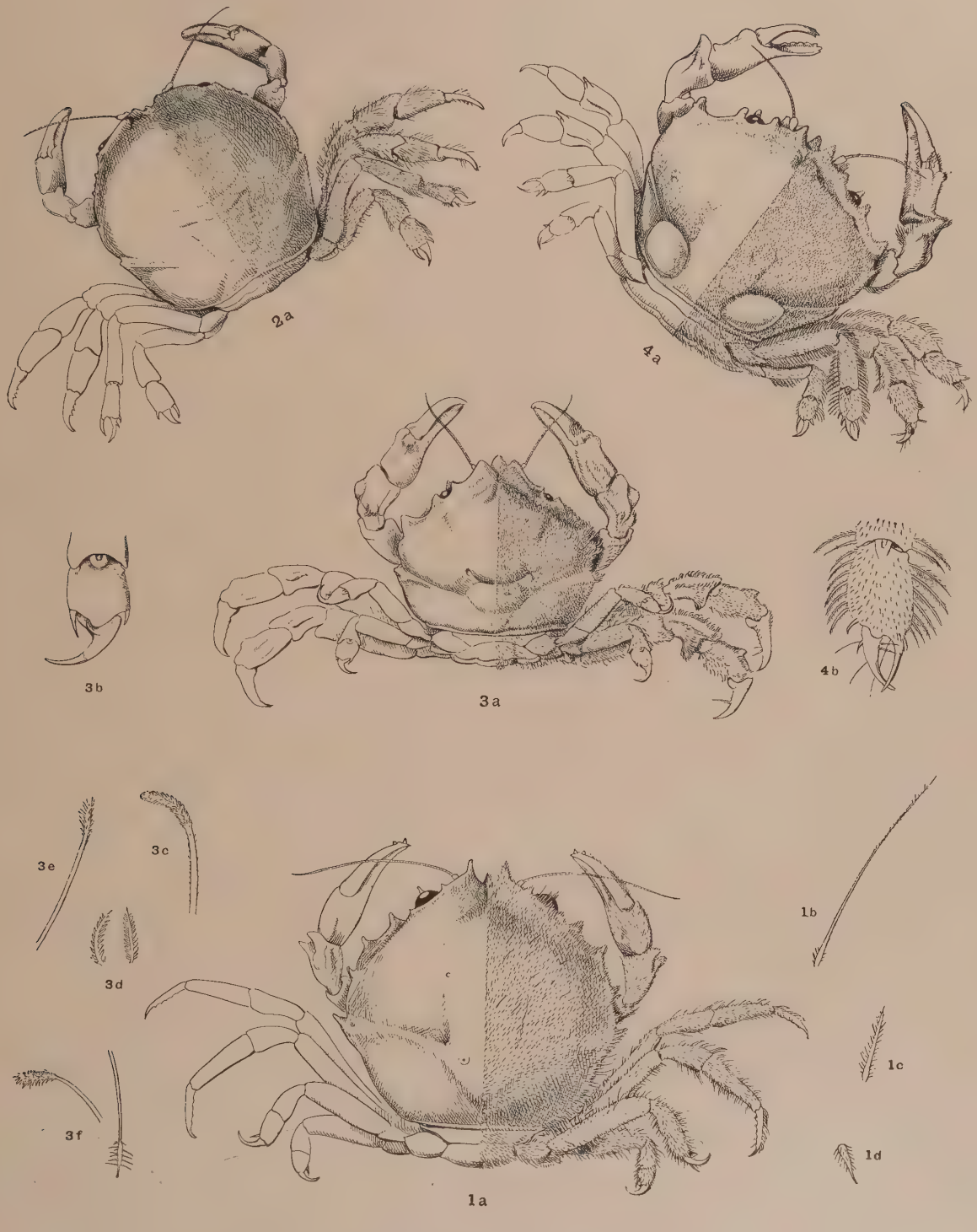
EXPLANATION OF PLATE XXXIII.

FIG. 1. *Dromia rumphi*, young individual; *a.* whole animal, *b.* one of the long hairs on the back; *c*, *d.* short hairs on the back.

FIG. 2. *Dromidiopsis tridentatus*; *a.* whole animal, from above. The carapace is rather longer than is shown in the figure.

FIG. 3. *Cryptodromia hirsuta*; *a.* whole animal, *b.* end of the fifth leg, *c.* one of the hairs on the ridge overhanging the furrow just behind the front, *d.* small hairs on the back, *e.* long hair on the back, *f.* hairs on the legs.

FIG. 4. *Cryptodromiopsis tridens*; *a.* whole animal, *b.* end of the fifth leg.



E. W. del.

BORRADAILE——DROMIACEA.

To face p. 578.

ON A LAND PLANARIAN FROM HULULE, MALE ATOLL,

WITH A NOTE ON *LEPTOPLANA PARDALIS* LAIDLAW.

By Frank Fortescue Laidlaw, B.A. (Cantab.).

A single specimen was found of a small species of *Rhynchodemus* under decaying wood. Its total length is about 25 mm. and breadth a little under 2 mm.

After some hesitation I have referred it to von Graff's *Rhynchodemus ceylonicus*[1], a species of which a single specimen was collected by the brothers Sarasin in Ceylon. This the type specimen is considerably larger than that found by Mr Gardiner (48 mm. long by 3 mm. in breadth), but the colouring agrees fairly well, although owing to the fact that the specimen under discussion has been treated with corrosive sublimate it has rather faded.

There is a somewhat obscure median dorsal dark band and two feebly marked broader lateral bands. Near the middle of the body the small bell-shaped pharynx is protruded.

No land planarian has hitherto been recorded from any coral island in the Indian Ocean. Other islands remote from continental land in this Ocean have, however, a small number of inhabitants belonging to this group. Such are the Seychelles with two species of *Amblyplana*, and Rodriguez with one species *Geoplana whartoni* of Gulliver, who also observed a specimen of land planarian on Mauritius. The planarian fauna of these islands is considered by von Graff to be derived from that of the Aethiopian region, whilst the Maldivian species is clearly derived from Ceylon where the genus *Rhynchodemus* is fairly abundant.

Certain Oriental species of the genus have a wide distribution, such for example is *Rhynchodemus nematoides* Loman, which is recorded from Ceylon and Java by von Graff in his monograph of the land planarians, whilst I have examined specimens from a height of 2500 ft. from a hill in the north-east of the Malay Peninsula.

Species of land planarians are known to occur on at least two coral islands in the Pacific. One of these is *Rhynchodemus putzei* v. Gr. from the Marquesas Is., the other is *Geoplana pelewensis* v. Gr. from the Pelew Is.

[1] von Graff, *Monographie die Turbellaria* III. *Tricladida terricola.*

Note on *Leptoplana pardalis* Laidlaw.

Since my account[1] of Mr Gardiner's marine planarians was published, I find that I had inadvertently overlooked the description of *Leptoplana subviridis* v. Plehn, given by von Plehn in Semon's *Zool. Forschungreisen*, 5, III. p. 330, Pl. XXIII. figs. 11, 12. Since three of the four species described and figured in this paper are also described with the same figures in von Plehn's previous paper in the *Jena Zeitschrift*, I had carelessly put the former on one side, supposing that all the species described in it were also described in the latter.

I find now that the species which I overlooked is identical with my *Leptoplana pardalis*, which therefore becomes merely a synonym of *L. subviridis*. I find, however, that there are certain discrepancies between our accounts especially as concerns the male apparatus. I have re-examined my sections in consequence and give the following comments.

As regards the vesicula seminalis, von Plehn states that the vasa deferentia have muscular walls and open together into a vesicula seminalis. In my account I stated that the lower ends of the vasa deferentia were dilated to form a pair of vesiculae which opened into a ductus ejaculatorius. In favour of this latter view I find that in my specimens at any rate, the ends of the vasa deferentia are distinctly dilated, and that the vessel called the vesicula by von Plehn is narrow and of the same diameter throughout, until it decreases on approaching the penis. In support of von Plehn's view is the fact that her interpretation is more in accord with the condition usually found in Leptoplanas. I am inclined to believe that both views may be right in this case, *i.e.* that either the lower ends of the vasa deferentia, or the part which I have called the ductus ejaculatorius may function as a vesicula seminalis.

Von Plehn's specimen does not appear to have shown the very distinct narrowing of the two parts of the accessory vesicle and their subsequent dilatation to form a receptaculum seminis on either side, so that each receptaculum is placed as it were on a distinct stalk.

The synonymy of this species then stands as follows:

Leptoplana subviridis v. Plehn.

L. subviridis von Plehn. Semon's *Zool. Forschungreisen*, 5, III. p. 330. Tf. XXIII. figs. 14, 15.

L. pardalis Laidlaw. *Faun. and Geogr. of the Maldives and Laccadives*, I. 3, p. 287, Pl. XIV. fig. 9, Pl. XV. fig. 14. *Ibid., Proc. Lit. and Phil. Soc. Manchester*, XLVII. (1903), no. 5.

I take the opportunity of thanking Mr Stanley Gardiner for permission to call attention to my oversight, which I greatly regret to have committed.

[1] "The Marine Turbellaria, etc." *Fauna and Geography, Maldives and Laccadives*, vol. I. pp. 281—310 (1902).

LAGOON DEPOSITS.

I. GENERAL ACCOUNT.

By J. Stanley Gardiner, M.A.

II. REPORT ON CERTAIN DEPOSITS.

By Sir John Murray, K.C.B., F.R.S.

(With Plate XXXIV.)

I. GENERAL ACCOUNT (by J. Stanley Gardiner)[1].

In Appendix A, Section II. of my article on "The Maldive and Laccadive Groups" (vol. I. pp. 317—323), I have already referred to some of the deposits found in the atolls and on the banks which we visited. I am greatly indebted to Sir John Murray for kindly examining and giving me the accompanying Report on certain deposits from the lagoons of the atolls which I submitted to him. Perhaps the Section above referred to should be read a second time in connection with this Report, though the latter does not, so far as I can see, invalidate any conclusions therein expressed as to the formation of lagoons, but on the contrary lends them additional important support.

On the most open banks, such as Miladumadulu and North Mahlos, we found, generally speaking, either a hard bottom without any deposit or else a deposit formed by very coarse broken coral and shell fragments, leaves of Halimeda and allied algae, together with a few bottom-living Foraminifera of large size. As might have been expected, there did not appear to have been anywhere a deposit of any thickness except to leeward of certain reefs, where it might have the characters of nos. 11 and 12 of Sir John Murray's Report.

Within shallow atolls, or banks which had assumed the atoll shape, the bottom, except along the lines of the currents, was commonly covered by a deposit of white sand. This was always quite loose and never coherent in any way. It consisted of fine fragments of the same materials as on the more open banks, all more or less rounded or smoothed. Except that the remains of pelagic organisms were rarer, the deposit was the same as that which formed the sand of the lagoon-ward parts of the islands (nos. 14 and 15). The grains varied in size, being in enclosed situations extremely small, such as the centre of Minikoi (no. 16), except for leaves of Halimeda and broken shells. In this position no doubt a great part of the deposit was formed by the washings off the land, but that from the velu (lagoon) of Bodu Faro, North Mahlos, a quite open faro (atollon) 13 fathoms in depth, approaches rather to a mud (no. 13). Nos. 17—19 are also examples of coral sands from the neighbourhood of passages into the lagoon of Suvadiva, where currents of greater or lesser force are felt.

[1] Sir John Murray suggested that I should give some general account of these deposits, as I necessarily had a local knowledge of the region, which he did not himself possess. Consequently, I alone am responsible for any statements or opinions contained in this Section.

It is on this sand deposit that the greatest amount of free animal life is found, while sedentary animals tend to settle upon the more current-swept areas. Among the latter forms are certain *Polyzoa* and *Polytrema*, which completely grow round small fragments of stone, turning them into more or less round balls, various Alcyonaria, a few sponges and tunicates and corals of such genera as *Dendrophyllia*, *Alveopora*, *Goniopora*, etc. Of the free forms in the coral sand small lamellibranchs and gastropods are numerous, as well as young echinids. Crustaceans, particularly Portunidae and Oxystomata as well as Macrura, abound. Certain holothurians, sipunculids and polychaets, as well as *Ptychodera* and Cephalochorda in certain parts of the shallower waters, are quite numerous. Corals are found only where the sand is moderately coarse, and there is some current, but then such forms as *Diaseris*, *Goniopora stokesi*, *Heteropsammia* and *Stephanoseris* were remarkably abundant locally. Indeed, dead coralla of the first-named were found to be forming the greater part of a series of consolidating masses of rock, dredged from an eddy in one of the northern passages of Suvadiva atoll, of which no. 23 was a specimen.

Lastly, within the most enclosed parts of certain banks and within the lagoons of the deeper atolls a greenish grey ooze, almost a mud, was found (nos. 1—10, 20, 21, 24). A similar deposit may possibly have existed in quite shallow water and have been overlooked by us, but, so far as our soundings and dredgings went, there would almost seem to have been a critical depth at about 30 fathoms below which it was for some reason unable to form. It was generally a fairly clean mud, but below 40 fathoms, when fresh, unctuous, and sometimes smelling slightly of sulphuretted hydrogen. In Suvadiva atoll it was largely composed of the shells of Pteropoda, in which connection it is interesting to remark that one morning at the beginning of November, 1899, the water in the lagoon of Goifurfehendu was positively thick with the shells of *Clio*. Pelagic Foraminifera were common, but bottom-living species were by no means numerous. Sedentary organic life, except sponges, scarcely existed upon it, while free life was only represented by a few species of Crustaceans and a still smaller variety of flat fishes. A holothurian was dredged from this class of bottom (p. 339); it was of peculiar interest on account of the relatively large fragments of coral contained in its gut (no. 25).

The most interesting point about this muddy deposit from Suvadiva is the presence in it of large quantities of casts of various organisms, more especially Foraminifera. Its mineralogical constituents are small, and are for the most part those found in the open ocean, being of volcanic origin. In connection with this, one may point out that on the shores of many of the islands there are lines of pumice, which the natives state were washed up about 1885, and would hence have probably owed their origin to the eruption of Krakatoa in 1883. In addition half-decomposed pumice is found, in places at some considerable distance inland, which evidently belonged to an earlier period. The analogy between these casts and those of Greensand appears to me to be very close, and I would suggest that here we have an incipient formation of the latter deposit, which is generally supposed to be largely terrigenous in origin. Greensand essentially owes its origin to the filling in of the shells, particularly of the Foraminifera, by a deposit. It was shown in the Challenger Reports to occur between 100 and 900 fathoms along bold and exposed coasts, where pelagic conditions might be expected to closely approach the shores, though all the elements of its essential constituent, glauconite, may also be present in pumice or the ordinary oceanic, volcanic deposits. That there is any real homology between this deposit and that of Greensand is by no means certain, but, if there be, either the formation of Greensand must depend on physical conditions rather than the proximity of continental land, or Suvadiva atoll at least must have been closely connected with or perhaps founded on the remains of a continental land mass.

So far as I am aware this is the first recorded occurrence of a true pelagic deposit, *i.e.* Pteropod Ooze, within the lagoon of an atoll. It is accompanied by much fine matter, the inorganic part of which consists almost entirely of carbonate of lime. The Challenger Report recorded the presence of a similar deposit off many coral reefs and oceanic islands, that around the Fiji Group being particularly noticeable, though in my own experience it is not found in the lagoons of the atoll or barrier reefs of those islands. The presence of this deposit in Suvadiva lagoon at depths over 40 fathoms is interesting as it is not found elsewhere in the shallower lagoons we investigated, and it would naturally be expected that the calcareous remains of such small pelagic organisms would have been rapidly dissolved in the sea-water and removed. A considerable proportion of the deposit being formed of casts shows that its origin cannot have been due to merely temporary causes. It might reasonably be deduced that the lagoon of Suvadiva below 35 or 40 fathoms is a relatively still one with little circulation in its sea-water, but the reason of this state is not obvious, as that atoll has 38 well-defined passages into its lagoon, of which 7 are about or over 35 fathoms in depth, and 17 about or over 20 fathoms. It is useless, however, theorising on the subject, when it is obvious that practically nothing is known of the physical conditions of this large lagoon. In connection with the question it will be interesting to see what deposits Prof. Agassiz found around the Maldive banks at moderate depths. The presence or absence of manganese nodules or deposits, indicated in no. 24 below, will no doubt be considered also by the same author.

I have appended a chart to Sir John Murray's Report (Pl. XXXIV), underlining the positions from which the samples from Suvadiva atoll were obtained. I add from the same Report a list of the animals of such groups as will otherwise not be treated of in this publication. Names in brackets have been added by me, the bracketed genera of the Foraminifera having been kindly identified by Mr J. J. Lister.

Pelagic Foraminifera:

Globigerina bulloides.
" *sacculifera.*
" *conglobata.*
" *digitata.*
" *rubra.*
Globigerina aequilateralis.
" *dubia.*
Orbulina universa.
Sphaeroidina dehiscens.
Pullenia obliquiloculata.
Pulvinulina tumida.
" *menardii.*
" *canarinensis.*
Cymbalopora.

Bottom Foraminifera:

Biloculina.
(*Miliolina*).
Spiroloculina.
Peneroplis.
(*Orbitolites*).
(*Alveolina*).
Rheophax.
(*Textularia*).
Cassidulina.
Lagena.
Nodosaria.
Polymorphina.
Uvigerina.
Pullenia sphaeroides.
Rotalinae.
Polytrema.
(*Gypsina*).
Amphistegina.
(*Polystomella*).
(*Operculina*).
Heterostegina depressa.

Mollusca Pteropoda:

Clio subula.
" *australis.*
Limacina.
Cavolinia.

Mollusca Heteropoda:

Atlanta.
Carinaria.
(*Oxygurus*).
(*Pterotrachea*).

Other Mollusca:

Pleurotoma.
Dentalium.

Diatomaceae:

Pleurosigma.
Surirella.
Coscinodiscus.

Number	Depth in fathoms	Designation and Physical Characters	Carbonate of Calcium	
			Per cent.	Organisms
1.	42	Pteropod ooze, greyish green in colour, slightly coherent, fine grained, contains many Pteropod fragments. **Residue,** green, flocculent.	80	Pteropods (*Clio subula, C. australis, Cavolinia*) and fragments, pelagic Foraminifera (*Globigerina bulloides, G. sacculifera, G. conglobata, G. digitata, G. rubra, G. aequilateralis, Pulvinulina tumida, P. menardii, P. canarinensis, Pullenia obliquiloculata, Orbulina universa, Sphaeroidina dehiscens*), bottom-living Foraminifera (*Nodosaria, Rotalidae, Biloculina, Rheophax, Uvigerina*), Otoliths, Ostracodes, Echini spines, larval Molluscs, Heteropods (*Atlanta*), calcareous coprolites, coccoliths and rhabdoliths.
2.	43	Pteropod ooze, green in colour, fine grained, coherent. **Residue,** heavy, black or dark green.	70	Pteropods (*Clio subula, C. australis, Cavolinia*), Heteropods (*Atlanta, Carinaria*), pelagic Foraminifera (*Globigerina bulloides, G. sacculifera, G. digitata, G. aequilateralis, G. conglobata, G. rubra, G. dubia, Orbulina universa, Sphaeroidina dehiscens, Pullenia obliquiloculata, Pulvinulina tumida, P. menardii, P. canarinensis*), bottom-living Foraminifera (*Uvigerina, Rotalidae, Biloculina, Nodosaria*), larval Gastropods and Lamellibranchs, Ostracodes, Otoliths, Echini spines, *Serpula*, calcareous coprolites, fish teeth, coccoliths, rhabdoliths and coccospheres.
3.	44	Coral sand, cream in colour, incoherent. **Residue,** brown, flocculent.	90	Coral fragments, one or two small bivalve shells, larval Lamellibranchs and Gastropods, Pteropods (*Clio australis, C. subula*), Echini spines, bottom-living Foraminifera (*Amphistegina, Rotalidae, Spiroloculina, Biloculina, Nodosaria*), Otoliths of fish, Ostracodes, pelagic Foraminifera (*Globigerina bulloides, G. rubra, Sphaeroidina dehiscens, Pullenia obliquiloculata, Orbulina universa*), Tunicate spicules.
4.	44	Coral mud, greenish grey, fine grained, incoherent. **Residue,** green.	96	Coral fragments, Pteropods (*Clio subula, C. australis, Cavolinia*), Heteropods (*Atlanta*), larval Lamellibranchs and Gastropods (*Pleurotoma, Dentalium*), Echini spines and shells, bottom-living Foraminifera (*Nodosaria, Rotalidae*), fragments of Crustacean tests and claws, pelagic Foraminifera (*Globigerina bulloides*), Ostracodes, Otoliths of fish, Tunicate spicules, *Serpula*, coccoliths.
5.	46	Pteropod ooze, green in colour, incoherent. **Residue,** dark green, flocculent.	90	Pteropods (*Clio subula, C. australis, Cavolinia*), Heteropods (*Atlanta*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata, G. sacculifera, G. digitata, G. aequilateralis, G. dubia, G. rubra, Orbulina universa, Sphaeroidina dehiscens, Pulvinulina tumida, P. menardii, Pullenia obliquiloculata, Cymbalopora*), bottom-living Foraminifera (*Spiroloculina, Cassidulina, Pullenia sphaeroides, Amphistegina, Rotalidae, Uvigerina*), larval Lamellibranchs and Gastropods, Otoliths, Ostracodes, rhabdoliths, coccoliths and coccospheres.
6.	47	Pteropod ooze, brownish grey, incoherent. **Residue,** brown, flocculent.	80	Pteropods (*Clio subula, C. australis, Limacina, Cavolinia*), Heteropods (*Atlanta, Carinaria*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata, G. aequilateralis, G. sacculifera, Orbulina universa, Sphaeroidina dehiscens, Pullenia obliquiloculata, Pulvinulina tumida, P. menardii*), Echini spines, larval Lamellibranchs and Gastropods, Ostracodes, Otoliths of fish, bottom-living Foraminifera (*Amphistegina, Rotalidae*), Tunicate spicules, rhabdoliths.
7.	48	Pteropod ooze, greenish grey, incoherent. **Residue,** greenish brown, flocculent.	90	Pteropods (*Clio subula, C. australis*), Heteropods (*Atlanta*), pelagic Foraminifera (*Globigerina bulloides, G. rubra, G. sacculifera, G. conglobata, G. aequilateralis, Pulvinulina menardii, P. tumida, Orbulina universa, Sphaeroidina dehiscens*), bottom-living Foraminifera (*Uvigerina, Cassidulina, Polymorphina, Biloculina*), Echini spines, Tunicate spicules, larval Gastropods and Lamellibranchs, Ostracodes, coccoliths, calcareous coprolites.

Residue				Position
Per cent.	Minerals	Siliceous Organisms	Fine Washings	
20	(2 °/₀), angular, mean diameter 0·15 mm., felspar, hornblende and magnetite.	(3 °/₀), arenaceous Foraminifera, sponge spicules, many perfect green clayey casts of Foraminifera, etc., Radiolaria.	(15 °/₀), amorphous clayey matter with minute fragments of siliceous organisms and minerals less than 0·05 mm. in diameter.	**Suvadiva,** N.N.E. 2½ miles S. b. W. Mametu.
30	(1 °/₀), angular, mean diameter 0·1 mm., felspar and magnetite. No manganese observed.	(5 °/₀), sponge spicules, Radiolaria, many clayey casts of Foraminifera, clayey coprolites, diatoms.	(24 °/₀), amorphous clayey matter with minute mineral particles less than 0·05 mm. in diameter, etc.	**Suvadiva,** N.E. 4½ miles W. Digura.
10	(1 °/₀), angular, mean diameter 0·06 mm., felspar only observed.	(3 °/₀), diatoms, sponge spicules.	(6 °/₀), amorphous clayey matter, with one or two minute mineral particles.	**Suvadiva,** S.E. 2 miles N. Noorbhai I.
4	(1 °/₀), angular, mean diameter 0·08 mm., fragments of glass and felspar, one particle of felspar measured 0·14 mm.; flakes of iron rust, probably off the machine used in collecting the sample, were also observed. No manganese observed.	(2 °/₀), sponge spicules, Radiolaria, Diatoms (*Pleurosigma*, *Surirella*, *Coscinodiscus*), and many beautiful green clayey casts of Gastropods, Echini spines, Foraminifera, etc., coprolites, no casts in Pyrite.	(1 °/₀), amorphous clayey matter, with minute fragments of siliceous organisms, and small mineral particles less than 0·05 mm. in diameter.	**Suvadiva,** S.E. 1¾ miles N.W. Fulu I.
10	(2 °/₀), angular, mean diameter 0·15 mm., felspar and glass, many casts of Foraminifera, etc. but not so perfect as in the dry sample (no. 4). No manganese.	(5 °/₀), sponge spicules, Radiolaria, small sponge, arenaceous Foraminifera, Diatoms.	(3 °/₀), amorphous clayey matter, small casts, etc.	**Suvadiva,** S. 2 miles W.S.W. Mafe I.
20	(2 °/₀), angular, mean diameter 0·07 mm., felspar only observed.	(4 °/₀), sponge spicules, Radiolaria, Diatoms, one or two white clayey casts.	(14 °/₀), amorphous clayey matter with minute mineral particles and fragments of siliceous organisms.	**Suvadiva,** S. 3 miles further W. than last.
10	(1 °/₀), angular, mean diameter 0·07 mm., felspar, hornblende and magnetite.	(3 °/₀), sponge spicules, Radiolaria, Diatoms.	(6 °/₀), amorphous clayey matter with minute mineral particles less than 0·05 mm. in diameter and fragments of siliceous organisms.	**Suvadiva,** S. 2 miles further W. than last.

Number	Depth in fathoms	Designation and Physical Characters	Carbonate of Calcium	
			Per cent.	Organisms
8.	44	PTEROPOD OOZE, greenish grey, fine grained, incoherent. **Residue,** one or two black particles, very little clayey matter, green in colour.	90	Pteropods (*Clio subula, C. australis, Limacina*), Heteropods (*Atlanta*), Coral fragments, bottom Foraminifera (*Rotalidae, Amphistegina*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata, Pulvinulina menardii, Cymbalopora*), Echini spines, larval Lamellibranchs and Gastropods.
9.	43	PTEROPOD OOZE, greenish grey in colour, fine grained, incoherent. **Residue,** green casts, very little flocculent matter.	90	Pteropods (*Clio australis, C. subula, Limacina, Cavolinia*), Heteropods (*Atlanta, Carinaria*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata, G. sacculifera, G. aequilateralis, G. rubra, Orbulina universa, Sphaeroidina dehiscens, Pulvinulina menardii, P. tumida, Cymbalopora, Pullenia obliquiloculata*), bottom-living Foraminifera (*Rotalidae, Pullenia sphaeroides, Uvigerina, Amphistegina*), Echini spines, Otoliths, Ostracodes, Alcyonarian spicules, Tunicate spicules, larval Lamellibranchs and Gastropods.
10.	30	CORAL SAND, greenish grey, incoherent. **Residue,** green.	90	Fragments of Coral and Mollusc shells, larval Lamellibranchs and Gastropods, Otoliths of fish, Ostracodes, bottom-living Foraminifera (*Rotalidae, Amphistegina, Spiroloculina, Lagena, Biloculina*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata*), Pteropods (*Clio subula*), Echini spines, Tunicate spicules, Alcyonarian spicules, Coccoliths.
11.	28	CORAL SAND, cream coloured, fine grained, incoherent. **Residue,** grey, no clayey matter.	98	Coral fragments, Echini spines, calcareous Algae, Alcyonarian spicules, bottom-living Foraminifera (*Lagena, Amphistegina*), Tunicate spicules, larval Lamellibranchs and Gastropods, Crustacean claws, Ostracodes, and Otoliths of fish.
12.	20	CORAL SAND, cream coloured, incoherent. **Residue,** brown.	97	Coral fragments, Alcyonarian spicules, bottom-living Foraminifera (*Orbitolites, Amphistegina, Rotalidae*), calcareous Algae.
13.	8	CORAL MUD, white, finely granular, unctuous. **Residue,** a few grey particles, no clayey matter.	97	Fragments of Coral and calcareous Algae, Molluscs and fragments, bottom-living Foraminifera (*Miliolidae, Rotalidae, Peneroplis*, etc.), Tunicate spicules, Ostracodes, Otoliths of fish, also vertebrae and teeth of fish, Alcyonarian spicules, Echini spines, Polyzoa, pelagic Foraminifera (only *Cymbalopora* observed).
14.	0	CORAL SAND, loose, incoherent, granular, grey in colour. **Residue,** black.	90	Coral fragments, larval Lamellibranchs and Gastropods, bottom-living Foraminifera (*Orbitolites, Spiroloculina, Lagena*), Echini spines, Alcyonarian spicules, Polyzoa, calcareous Algae, Ostracodes, Otoliths of fish, pelagic Foraminifera (*Globigerina conglobata, G. aequilateralis*).
15.	0	CORAL SAND, cream colour, incoherent, gritty, largest piece of coral 13 mm. in diameter. **Residue,** brown vegetable matter.	97	Coral fragments, Mollusc shell fragments, larval Lamellibranchs and Gastropods, Echini spines, Alcyonarian spicules, bottom-living Foraminifera (*Orbitolites, Amphistegina, Rotalia*).
16.	8	CORAL SAND, white, granular, incoherent. **Residue,** grey particles.	98	Largely made up of fragments of calcareous Algae with coral fragments, Molluscs and fragments, bottom-living Foraminifera (*Miliolidae*), Tunicate spicules.

Residue				Position
Per cent.	Minerals	Siliceous Organisms	Fine Washings	
10	(1 °/₀), angular, mean diameter 0·6 mm., felspar and magnetite; no manganese or sulphide of iron observed.	(3 °/₀), sponge spicules, a few green clayey casts of Foraminifera; Coprolites; Diatoms.	(6 °/₀), amorphous clayey matter with minute fragments of siliceous organisms, casts and mineral particles less than 0·05 mm. in diameter.	**Suvadiva,** W. 1 mile W. b. S. of Velana I.
10	(1 °/₀), angular, mean diameter 0·6 mm., felspar and magnetite; no manganese grains observed.	(5 °/₀), green clayey casts of Foraminifera, etc.; grey and black clayey Coprolites; no manganese grains or sulphide of iron.	(4 °/₀), amorphous clayey matter, with minute mineral particles less than 0·05 mm. in diameter.	**Suvadiva,** W. 3 miles W. of Havaru Tinadu.
10	(3 °/₀), angular, mean diameter 0·3 mm., volcanic glass and felspar, one particle of felspar observed measured 0·55 mm. in diameter, and a fragment of volcanic glass measured 2 mm. in length. A small but perfect crystal, clear yellow in colour, and of a wedge shape, probably sphene (?), was also observed.	(2 °/₀), fragments of Radiolaria; Diatoms.	(5 °/₀), amorphous clayey matter with fragments of minerals and small Diatoms.	**Felidu,** middle of atoll.
2	(1 °/₀), angular, mean diameter 0·18 mm., particles of felspar only observed.	(1 °/₀), sponge spicules.	Practically none.	**North Mahlos,** middle east side.
3	(2 °/₀), angular, mean diameter 0·2 mm., felspar, hornblende and volcanic glass.	(1 °/₀), sponge spicules.	None.	**North Mahlos,** S.W. Close off Fusmundu.
3	(1 °/₀), one or two particles of felspar and glass.	(2 °/₀), sponge spicules, Radiolaria, Diatoms (*Surirella*, etc.).	None.	**North Mahlos,** W. Within lagoon of Bodu Furo.
10	(1 °/₀), angular, mean diameter 0·18 mm., particles of felspar observed only.	(1 °/₀), sponge spicules.	(8 °/₀), made up principally of vegetable fibre and a great many small brown cocoons of larvae (insect ?).	**Minikoi.** Soil of low planting ground, middle of island.
3	None.	(1 °/₀), sponge spicules.	(2 °/₀), vegetable fibre.	**Minikoi.** Soil from 3—4 feet deep near Lighthouse.
2	None.	(1 °/₀), one or two sponge spicules.	(1 °/₀), a few fragments of vegetable matter.	**Minikoi.** Centre of lagoon.

17. Coral sand. 31 *f.* **Suvadiva,** W. 1 mile E. of S. end of Hondedu.

Very little material which appears to have been washed, consisting of small fragments of Coral and Mollusc shells, one or two bottom Foraminifera (*Amphistegina, Rotalidae, Biloculina,* etc.), *Serpula.*

18. Coral sand. 30 *f.* **Suvadiva,** W. Opposite passage between Hondedu and Kandudu.

Very little material, appears to have had the finer material washed away; is grey in colour, granular, and made up mostly of Coral fragments, bottom Foraminifera (*Amphistegina, Rotalidae,* etc.), broken Mollusc shells, Diatoms, etc.

19. Coral sand. 33 *f.* **Suvadiva,** W. 1 mile N. of last (not shown on Chart).

White, gritty, no fine material, made up of Coral fragments, bottom Foraminifera (*Amphistegina, Heterostegina depressa*), *Serpula,* Polyzoa.

20. Coral sand. 44 *f.* **Suvadiva,** W. 2 miles E. of Kandudu.

Cream colour, gritty, made up largely of fragments of Coral, bottom Foraminifera (*Amphistegina, Rotalidae*), Echini spines, larval Lamellibranchs and Gastropods, Pteropods (*Clio subula*), Alcyonarian spicules.

21. Pteropod ooze. 42 *f.* **Suvadiva,** W. 1½ miles N.E. of last.

Cream colour, incoherent, appears to be slightly washed, fine grained, contains Pteropods (*Clio subula, C. australis*), Heteropods (*Atlanta, Carinaria*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata, G. aequilateralis, G. rubra, Sphaeroidina dehiscens, Orbulina universa*), bottom Foraminifera (*Uvigerina, Cassidulina, Biloculina, Spiroloculina, Lagena, Rotalidae, Amphistegina*), Alcyonarian spicules, Tunicate spicules, Coral fragments, larval Lamellibranchs and Gastropods, Polyzoa, Otoliths of fish, Ostracodes.

22. Coral sand. 34 *f.* **Suvadiva,** W.N.W. 1 mile W. of Thackaru I.

Loose, gritty, grey in colour, made up of angular and rounded fragments of Coral and Mollusc shells, Polyzoa, *Serpula,* calcareous Algae, larval Lamellibranchs and Gastropods, Alcyonarian spicules, bottom-living Foraminifera (*Amphistegina, Polytrema, Rotalidae, Uvigerina, Nodosaria*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata*), Tunicate spicules, Otoliths, Ostracodes, Sponge spicules.

23. Coral conglomerate. 37—8 *f.* **Suvadiva,** N.N.W. In Huradu passage.

Piece of coral rock 4½ by 3 inches in diameter consisting of an intergrowth of cup corals, etc., covered with calcareous Algae, *Serpula,* Polyzoa, attached Mollusc shells, bottom Foraminifera (*Amphistegina, Rotalidae, Polytrema, Uvigerina,* etc.), larval Lamellibranchs and Gastropods.

24. 36 *f.* **Felidu.** Centre of S.E. horn.

The material is grey in colour with black particles, shells, etc. coated with Manganese, but no grains of Manganese observed; is gritty and incoherent, appears to be washed, contains small greyish black rock particles, the largest observed being about 3 mm. in maximum diameter. Larval Lamellibranchs and Gastropods (*Pleurotoma* and *Dentalium*), Echini spines, Polyzoa, Coral fragments, Alcyonarian spicules, Otoliths of fish, Ostracodes, pelagic Foraminifera (*Globigerina conglobata*), bottom Foraminifera (*Amphistegina, Rotalidae*), Pteropods (*Clio subula*), Tunicate spicules.

25. Sample taken from the gut of a large Holothurian. **Suvadiva,** between nos. 21 and 8 above.

The material is coarse and gritty, cream in colour, and consists of angular and rounded fragments of coral, Mollusc shells, Polyzoa, calcareous Algae, Echini spines, Alcyonarian spicules, bottom Foraminifera (*Orbitolites, Rotalidae, Polytrema, Amphistegina, Uvigerina, Nodosaria, Biloculina, Spiroloculina, Cassidulina*), pelagic Foraminifera (*Globigerina bulloides, G. conglobata, Sphaeroidina dehiscens*), Pteropods (*Clio subula, C. australis*), Heteropods (*Atlanta*), Ostracodes, Otoliths of fish, *Serpula,* larval Lamellibranchs and Gastropods, Sponge spicules, Radiolaria, Diatoms and minute particles of minerals, mean diameter 0·06 mm. consisting felspar and magnetite; one or two particles of vegetable matter and fibre were observed.

SUVADIVA ATOLL.

(Soundings in the lagoon by the Expedition. Samples described from those underlined.)

To face p. 588.

MARINE MOLLUSCA.

By Edgar A. Smith, I.S.O.

(With Plates XXXV. and XXXVI.)

As the first collection of Marine Mollusca of any importance that has hitherto been obtained at the Maldive Islands, that about to be described is of considerable interest. It consists of about 380 different species and probably comprises a large proportion of the forms which occur in these islands. That many have escaped notice and will eventually be collected by others is quite certain, but it seems probable that most of the larger species are represented in this collection and that it is only among the smaller and obscurer forms that many additional species will hereafter be discovered.

There are, however, certain common and widely distributed species which one would have expected to have been found, notably belonging to the genera *Conus, Terebra, Sistrum, Purpura, Nassa, Oliva, Solarium, Trochus* and *Circe.* It is also worthy of remark that certain genera which have representatives in the surrounding seas do not appear to have been met with. Of these I may mention *Fasciolaria, Rissoa, Patella, Eulima, Hydatina, Aplysia, Umbraculum* and *Mytilus.*

As might be expected the fauna is similar to that of other islands in the Indian Ocean, many of the species occurring in Ceylon, Mauritius, Madagascar, the Amirantes, Seychelles, and a great many ranging as far north as the Red Sea and Persian Gulf. Rather more than a seventh of the forms have been recorded from the Andamans, and probably many others occur at these and the neighbouring Nicobar group. It is well known that great numbers of marine molluscs have a very wide range, and therefore it is not surprising that many, in fact about three-fourths, of the Maldive shells are known to occur in the seas surrounding the Philippine Islands and the Malay Archipelago, and still further north about one-fourth of the species have been recorded from the islands of Japan. In the Pacific, from the East coast of Australia to the Loyalty Islands and Polynesia, rather over three-sevenths of the Maldive species have been recorded, many of them ranging all over both the Indian Ocean and the Malay region also. About one-third of the species are known from Ceylon, but doubtless many more occur there, although they may not have been recorded. About 177 species have been found at the Mauritius, the fauna of which has been more extensively worked than that of the Seychelles. With regard to the general distribution of the species about to be recorded, it is curious to observe that a larger proportion of them have previously been noted from the China Sea eastward and in the Pacific, than in the Indian Ocean, including the Red Sea and Persian Gulf.

The following table shows at a glance the distribution of the species as far as the writer has been able to ascertain without a very exhaustive search. The column under Malaysia includes species which occur in the China Sea, the Philippine Islands, Malay Archipelago, N. Australia, New Guinea, and as far east as the Solomon Islands. Under Polynesia are indicated the species which are met with either in E. Australia or at the Loyalty Islands, or at the various groups of islands of Polynesia.

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Solidula glabra	...	..	...	...	...	...	...	...	+	...
,, *nitidula*	...	...	+	+	...	...	...	...	+	+
,, *solidula*	+	...	+	+	...	...	+	...	+	+
,, *tessellata*	...	...	...	...	+	...	...	...	...	...
Bulla ampulla	+	+	...	+	+	+	+	...	+	+
Alys cylindrica	+	...	...	+	+	...	+	+	+	...
,, *naucum*	...	...	...	+	+	...	+	...	+	+
,, *succisa*	...	...	...	...	+	...	...	...	...	...
Volvatella cincta	...	...	...	...	...	...	+	...	...	...
Oxynoe delicatula	...	...	...	...	...	...	+	...	...	+
Cryptophthalmus minikoiensis, n. sp.	...	...	...	...	...	...	...	...	...	...
Conus arenatus	+	+	+	+	+	...	+	...	+	+
,, *betulinus*	+	+	+	+	+	+	+	...	+	...
,, *catus*	+	...	+	+	+	...	+	...	+	+
,, *ceylanensis*	+	...	...	...	+	...	+	+	+	+
,, *consors*	...	...	..	...	...	...	...	...	+	...
,, *distans*	+	...	...	...	...	...	...	...	+	...
,, *eburneus*	+	+	+	...	...	...	+	+	+	+
,, *ermineus*	...	...	...	...	...	...	+	...	+	...
,, *flavidus*	+	...	+	+	+	+	+	...	+	+
,, *generalis*	+	+	+	+	+	+	+	...	+	+
,, *glans*	+	...	...	...	...	...	+	+	+	+
,, *hebræus*	+	+	+	+	+	...	+	+	+	+
,, *lividus*	+	+	+	+	+	+	+	...	+	+
,, *miles*	+	+	+	+	...	...	+	+	+	+
,, *minimus*	...	...	...	...	+	+	+	+	+	+
,, *nussatella*	+	+	+	+	+	...	+	...	+	+
,, *pennaceus*	+	...	...	...	...	+	+	...	+	...
,, *quercinus*	...	+	...	...	+	+	+	...	+	+
,, *tendineus*	+	...	...	...	...	...	...	..	...	+
,, *tessellatus*	+	+	+	+	+	+	+	...	+	+
,, *textile*	+	+	+	+	+	+	+	+	+	+
,, *tulipa*	+	...	...	+	...	...	+	...	+	+
,, *zonatus*	...	...	...	...	...	...	+	...	...	...
Terebra maculata	+	...	+	+	+	+	+	...	+	+
,, *dimidiata*	+	+	+	+	...	...	+	+	+	+
,, *argus*	+	...	...	...	...	...	...	...	+	+
,, *oculata*	+	...	...	+	...	...	...	...	+	+
,, *subulata*	+	+	+	+	+	...	+	...	+	+
,, *crenulata*	+	+	...	+	+	...	...	...	+	+
,, *cingulifera*	+	...	...	...	...	...	...	...	+	+
,, *babylonia*	+	...	...	...	+	+	+	...	+	+
,, *monile*	...	...	...	+	...	...	...	...	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Terebra undulata	...	...	...	...	...	...	...	...	+	+
,, *affinis*	+	...	...	+	+	...	...	+	+	+
,, *columellaris*	...	...	...	...	...	...	...	...	...	+
,, *bruguieri*	...	...	...	+	...	...	...	...	+	...
,, *amœna*	...	...	...	...	...	...	...	+	+	...
,, *violascens*	...	...	...	...	...	...	...	...	+	...
,, *lanceata*	+	...	+	+	...	...	...	...	...	+
,, *celidonota*	...	...	...	...	...	...	...	...	...	...
Pleurotoma armillata	...	...	...	...	...	...	...	...	+	..
,, *bijubata*	...	...	...	...	...	...	...	...	+	...
,, *tigrina*	+	+	...	+	...	+	+	+	+	+
Drillia exasperata	+	...	...	...	...	..	...	...	...	...
Clathurella robillardi	+	...	...	...	...	...	...	...	...	...
Daphnella saturata	...	...	...	...	...	...	...	...	+	...
Oliva erythrostoma	+	+	...	+	+	...	+	...	+	+
Harpa ventricosa	+	+	+	+	+	+	+	...	+	+
,, *minor*	+	...	+	+	+	...	+	...	+	...
Marginella picturata	+	...	...	...	...	...	...	...	...	...
Mitra episcopalis	+	+	+	+	...	...	+	...	+	+
,, *pontificalis*	...	...	+	+	...	...	...	...	+	+
,, *tessellata*	...	...	...	...	...	...	...	...	...	+
,, *adusta*	...	...	...	...	...	...	...	...	+	+
,, *digitalis*	+	...	...	...	...	...	...	...	+	...
,, *crenifera*	+	...	...	...	...	+	...	+	+	...
,, *scabriuscula*	+	...	...	...	...	+	+	...	+	+
,, *variegata*	+	...	...	...	...	...	...	..	+	...
,, *cucumerina*	+	...	+	+	...	...	+	...	+	+
,, *filaris*	+	...	...	...	...	...	...	...	+	+
,, *insculpta*	...	...	...	...	...	...	+	...	...	...
,, *interlirata*	+	...	...	...	...	...	...	...	+	+
,, *literata*	+	...	...	+	+	+	+	+	+	+
,, *acuminata*	+	...	...	...	...	...	...	...	+	+
,, *auriculoides*	+	...	...	...	...	...	...	...	...	...
,, *exasperata*	+	+	...	+	...	...	...	+	+	...
,, *sculptilis*	...	...	...	...	...	...	...	...	+	...
,, *acupicta*	+	...	...	...	...	+	...	+	...	...
,, *armigera*	...	...	...	...	...	...	...	...	...	...
,, *deshayesii*	+	...	...	...	...	...	...	+	...	+
,, *angustissima*, n. sp.	...	...	...	...	...	...	...	...	+	...
Cylindra sinensis	...	...	...	...	...	...	...	...	+	...
Latirus craticulatus	+	...	...	+	+	...	...	...	+	+
,, *fastigium*	...	...	...	...	...	...	+	+	...	...
Peristernia nassatula	+	+	...	+	+	...	...	+	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Leucozonia smaragdula	+	+	+	+	...	...	...	...	+	+
Cynodonta cornigera	+	...	...	+	+	...	+	...	+	+
Engina mendicaria	+	+	+	...	+	+	...	...	+	+
,, *bonasia*	+	...	...	+	...	...	+	...	...	...
,, *rawsoni*	...	...	...	...	...	+	...	...	...	...
Phos roseatus	...	...	...	...	+	+	...	+	+	...
,, *textilis*	...	...	...	...	...	...	...	...	+	...
Nassa bifaria	...	...	...	...	...	...	...	+	+	+
,, *marratii*	...	...	...	...	...	...	...	+	+	...
,, *monile*	...	...	...	..	...	...	+	+	+	...
,, *stigmaria*	...	...	...	...	...	+	...	+	+	+
,, *echinata*	...	...	...	...	...	...	...	...	+	+
,, *glans*	...	...	...	...	...	...	+	...	+	+
,, *granifera*	...	...	...	...	...	...	...	...	+	...
,, *maldivensis*, n. sp.	...	...	...	...	...	..	...	...	...	...
,, *mulukuensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *ecstilba*	...	...	...	...	...	...	...	...	...	+
,, *subtranslucida*, n. sp.	...	...	..	...	...	...	...	...	..	...
,, *disparilis*, n. sp.	...	...	...	...	...	...	...	...	...	...
Columbella conspersa	...	...	+	...	..	...	...	...	...	..
,, *flava*	...	...	...	...	...	...	+	+	...	...
,, *jaspidea*	...	...	...	...	...	...	...	...	+	...
,, *galaxias*	...	...	...	...	...	...	...	...	...	...
,, *turturina*	+	+	+	+	+	...	...	...	+	+
,, *varians*	...	...	...	...	+	...	...	...	+	+
Murex ternispina	...	...	...	...	+	+	+	...	+	...
,, *haustellum*	+	+	...	...	+	...	+	...	+	...
,, *tripterus*	+	...	...	...	...	...	...	...	+	...
,, *aculeatus*	...	...	...	...	...	...	...	...	+	...
,, *adustus*	+	+	...	...	...	...	+	+	+	+
,, *rubiginosus*	...	...	...	...	...	...	...	...	+	...
,, *ramosus*	+	+	+	+	...	...	+	...	+	+
,, *salmoneus*	...	...	...	...	...	...	...	...	...	...
,, *pleurotomoides*	...	...	...	...	...	...	...	...	...	...
,, *submissus*, n. sp.	...	..	...	...	...	...	..	...	...	...
Purpura armigera	+	...	+	+	...	...	...	...	+	+
,, *bitubercularis*	..	...	...	...	...	...	...	...	+	...
,, *hippocastanum*	+	...	+	+	+	+	+	...	+	+
,, *pica*	+	...	+	+	...	...	...	...	+	...
Iopas situla	...	...	...	...	...	...	...	...	...	+
,, *sertum*	+	...	...	+	+	...	+	+	+	+
Sistrum digitatum	+	+	...	+	...	...	...	...	+	...
,, *horridum*	+	+	+	+	+	...	+	...	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Sistrum ricinus	+	+	+	+	+	...	+	+	+	+
,, *tuberculatum*	+	+	+	+	+	...	+	...	+	+
,, *undatum*	+	+	...	+	+	...	...	+	+	+
,, *elatum*	...	...	...	...	+	...	...	...	+	...
,, *spinosum*	...	...	...	...	...	...	...	...	+	...
,, *biconicum*	...	...	...	...	...	...	+	...	+	...
,, *cavernosum*	...	...	...	...	...	...	...	...	+	...
,, *iostoma*	...	...	...	...	...	...	...	...	+	...
,, *squamosum*	...	...	...	...	...	...	...	...	...	+
,, *concatenatum*	+	...	...	...	...	...	+	...	+	...
,, *decussatum*	...	...	...	...	...	...	...	...	+	...
Coralliophila monodonta	+	...	...	...	+	...	...	...	...	+
,, *neritoidea*	+	+	+	+	...	...	+	...	+	+
,, *suturalis*	...	...	...	...	...	...	...	...	+	...
,, *squamosissima*	...	...	...	...	...	...	...	...	...	...
Leptoconchus ellipticus	+	...	...	...	...	...	...	...	...	...
,, *cumingii*	+	...	...	...	...	...	...	...	...	...
Lotorium chlorostoma	+	...	+	+	+	...	+	...	+	...
,, *gemmatum*	+	...	...	...	...	...	+	...	+	+
,, *pyrum*	+	...	...	...	...	...	...	...	+	...
,, *tuberosum*	+	+	+	+	+	...	+	...	+	+
Colubraria ceylonensis	...	...	...	...	...	+	+	...	+	...
,, *obscura*	+	...	...	...	...	...	...	...	+	...
,, *bracteata*	...	...	...	...	+	...	...	...	+	+
,, *digitale*	...	...	...	...	...	...	...	...	+	+
Distortrix anus	+	+	...	+	+	...	+	...	+	...
Ranella bufonia	+	...	+	+	+	...	+	...	+	...
,, *granifera*	+	...	...	+	+	...	+	...	+	+
,, *lampas*	+	+	+	+	+	+	+	...	+	...
,, *tuberosissima*	+	...	...	...	...	...	...	...	+	...
,, *thomae*	+	...	...	...	...	...	...	...	...	...
Cassis cornuta	+	...	...	...	...	...	+	...	+	...
,, *rufa*	+	...	+	+	+	...	+	...	+	+
Malea pomum	+	+	...	...	+	...	...	...	+	+
Dolium costatum	+	...	...	...	...	...	...	...	+	...
,, *olearium*	+	+	...	...	+	+	+	...	+	+
Pirula ficoides	+	+	...	...	...	...	+	...	+	...
Cypræa annulus	+	...	+	+	+	+	+	+	+	+
,, *arabica*	+	+	+	+	+	...	+	+	+	+
,, *argus*	+	+	+	+	...	...	+	...	+	+
,, *asellus*	+	+	...	+	+	...	+	+	+	+
,, *caput-serpentis*	+	+	+	+	+	...	+	...	+	+
,, *carneola*	+	+	+	+	+	+	+	+	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Cypræa caurica	+	+	+	+	+	+	+	+	+	+
,, *clandestina*	+	...	...	...	...	...	+	...	+	...
,, *cribraria*	+	...	...	...	...	...	+	...	+	+
,, *erosa*	+	+	+	+	+	+	+	+	+	+
,, *felina*	+	...	...	...	+	+	+	...	+	...
,, *gangrenosa*	...	...	...	...	...	...	+	+	+	...
,, *globulus*	+	...	...	...	...	...	+	...	+	+
,, *helvola*	+	+	+	+	+	...	+	+	+	+
,, *hirundo*	+	...	...	...	...	...	+	...	+	+
,, *isabella*	+	+	+	+	+	...	+	+	+	+
,, *lamarckii*	+	...	...	...	...	...	...	...	+	+
,, *lynx*	+	+	+	+	+	...	+	+	+	+
,, *mauritiana*	+	+	...	+	+	+	+	...	+	+
,, *minoridens*	+	...	...	+	...	...	...	...	...	+
,, *moneta*	+	...	+	+	+	+	+	...	+	+
,, *poraria*	+	...	...	...	...	...	+	...	+	+
,, *staphylæa*	+	...	...	+	+	...	+	+	+	+
,, *talpa*	+	+	+	+	+	...	+	...	+	+
,, *tigris*	+	+	+	+	+	...	+	...	+	+
,, *vitellus*	+	+	+	+	+	...	+	+	+	+
,, *walkeri*	...	...	...	...	...	...	...	...	+	+
,, *ziczac*	+	...	...	...	...	+	+	...	+	...
Trivia pellucidula	...	...	...	...	...	...	...	...	+	+
Strombus dentatus	+	...	...	...	+	...	...	...	...	...
,, *floridus*	+	+	...	+	+	...	...	...	+	+
,, *gibberulus*	+	+	+	+	+	+	+	+	+	+
,, *labiosus*	..	...	...	...	...	...	+	...	+	...
,, *lentiginosus*	+	...	...	+	...	...	+	...	+	+
,, *guttatus*	...	...	...	...	...	...	...	...	+	...
,, *lamarckii*	...	...	...	...	...	...	+	...	+	...
Pterocera lambis	+	+	...	...	+	+	+	...	+	+
,, *chiragra*	+	+	+	+	+	...	+	...	+	...
Terebellum terebellum	+	...	...	+	...	+	+	...	+	...
Triforis corrugatus	...	...	...	...	...	...	...	...	+	+
,, *elegans*	...	...	...	...	...	...	...	...	+	...
,, *sculptus*	...	...	...	..	...	...	...	+	+	...
,, *lilaceocinctus*, n. sp.	+	...	...	..	...	...	...	...	...	...
,, *excellens*, n. sp.	...	..	...	...	...	...	...	...	...	...
,, *gracilis*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *pura*, n. sp.	...	...	...	...	...	...	...	...	...	...
Vertagus articulatus	...	...	...	...	...	...	...	...	+	...
,, *fasciatus*	...	...	+	+	+	+	+	...	+	+
,, *kochi*	+	...	...	...	+	...	...	+	+	...

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Vertagus obeliscus	+	...	+	+	+	...	+	+	+	+
Cerithium columna	+	...	...	...	+	...	...	...	+	+
,, *echinatum*	+	+	+	+	...	...	...	...	+	...
,, *lacteum*	+	...	...	...	...	...	...	...	+	+
,, *piperitum*	...	...	...	...	...	...	...	...	+	...
,, *salebrosum*	...	...	...	...	...	...	...	...	+	...
,, *tuberculatum*	...	...	...	...	+	...	...	...	+	+
,, *albovaricosum*	...	...	...	...	...	...	...	...	...	+
Terebralia palustris	...	+	+	+	+	...	+	...	+	...
Modulus tectum	+	+	...	+	+	...	...	...	+	+
Planaxis ineptus	..	...	...	...	...	...	+	...	...	...
Littorina glabrata	+	+	+	+	+	...	...	...	+	...
,, *scabra*	+	+	+	+	...	...	+	+	+	+
,, *undulata*	...	...	...	...	...	...	+	+	+	+
Solarium modestum	...	...	...	...	...	...	...	...	+	+
Philippia cingulum	+	...	...	...	...	...	...	+	+	+
Mitrularia cicatricosa	...	...	...	...	+	...	...	...	+	...
,, *equestris*	+	...	...	...	...	+	...	+	+	...
Hipponyx danieli	...	...	...	...	...	...	...	...	...	+
,, *australis*	...	...	...	...	...	...	+	+	+	+
Thyca crystallina	...	...	...	...	...	...	...	+	...	+
Xenophora indica	...	...	...	...	...	...	...	+	+	...
Vanicoro cancellata	+	...	...	...	...	+	...	...	+	+
Natica robillardi	+	...	...	...	...	...	...	...	...	...
,, *euzona*	...	...	...	...	...	+	...	...	+	...
Polinices mamilla	+	+	+	+	+	+	+	+	+	+
,, *albumen*	...	...	...	...	...	...	+	...	+	...
,, *melanostoma*	+	+	+	+	+	+	+	...	+	+
,, *simiae*	+	...	...	...	+	...	+	+	+	...
Ianthina communis	+	+	+	+	+	...	+	...	+	+
Scala replicata	...	...	...	...	...	+	...	...	...	+
,, *consors*	...	...	...	...	...	...	...	...	...	+
,, *texta*, n. sp.	...	...	...	...	...	...	...	...	...	...
Pyramidella corrugata	+	...	...	...	...	...	...	...	...	...
,, *nodicincta*	...	...	...	...	...	...	...	...	+	...
Obeliscus dolabratus	+	...	...	+	+	...	+	+	+	+
,, *monilis*	...	...	...	...	...	...	...	...	+	...
,, *sulcatus*	+	...	...	+	+	+	...	+	+	+
Nerita albicilla	+	+	+	+	+	+	+	...	+	+
,, *histrio*	...	...	...	...	...	...	...	...	...	+
,, *plicata*	+	+	...	+	+	...	+	...	+	+
,, *polita*	+	+	+	+	+	+	+	...	+	+
Turbo argyrostoma	+	...	+	+	...	...	...	...	+	+

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Liotia squamicostata, n. sp.	...	...	...	...	...	...	...	...	...	...
Trochus incrassatus	...	...	...	...	...	...	...	+	+	...
,, *maculatus*	...	+	...	...	+	...	...	...	+	+
,, *obesus*	...	...	...	..	...	...	...	...	...	...
,, *radiatus*	...	+	...	..	+	+	+	...	+	...
Thalotia maldivensis, n. sp.	...	...	...	...	...	...	...	...	...	...
Clanculus atropurpureus	...	...	...	...	...	...	...	...	+	+
Perrinia angulifera	...	...	...	...	...	...	...	...	+	...
Forskalia pulcherrima	...	...	...	...	...	...	...	+	+	...
Monilia calyculus	...	...	...	...	...	...	...	+	+	..
,, *simulans*	...	...	...	...	...	...	...	...	+	...
Ethalia rhodomphala, n. sp.	...	...	...	...	...	...	...	...	...	...
Gena auricula	...	...	...	...	...	...	...	...	+	...
Haliotis ovina	...	...	...	...	...	...	...	...	+	+
Glyphis bombayana	...	...	...	...	...	...	...	...	...	...
,, *singaporensis*	...	...	...	...	...	...	...	...	+	...
Emarginula incisura	...	...	...	...	...	...	...	...	...	...
,, *planulata*	...	...	...	...	. .	...	...	...	+	...
Chiton miles	...	...	...	...	...	...	...	...	+	...
Schizochiton incisus	...	...	...	...	...	...	...	...	+	...
Callochiton platessa	...	...	...	...	...	...	...	...	...	+
Ischnochiton hululensis, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *feliduensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *maldivensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
Acanthochites laqueatus	...	...	...	...	...	...	+	...	+	...
Cryptoplax burrowi	...	...	...	...	...	...	...	...	...	+
Proneomenia australis	...	...	...	...	...	...	...	...	...	...
Spondylus imperialis	...	...	...	...	...	...	...	...	+	...
Lima fragilis	. .	...	...	...	...	...	...	...	+	+
,, *inflata*	...	...	...	...	...	...	...	...	+	...
,, *squamosa*	...	...	...	...	+	...	+	...	+	+
Pecten senatorius	...	...	...	...	+	...	+	...	+	...
,, *lemniscatus*	...	...	...	...	...	...	...	...	...	...
,, *mirificus*	+	...	...	...	...	...	...	...	+	...
,, *noduliferus*	+	...	...	...	...	...	...	...	...	...
,, *irregularis*	+	...	...	...	...	...	...	...	+	...
,, *nux*	...	...	...	...	...	...	...	...	...	+
,, *cooperi*, n. sp.	...	.	...	...	. .	...	...	...	...	...
,, *maldivensis*, n. sp.	...	...	...	...	...	...	...	...	...	...
Janira gardineri, n. sp.	...	...	...	...	...	...	...	...	...	...
Pallium plica	...	...	...	...	+	...	+	...	+	...
Amussium paucilirata, n. sp.	...	...	...	...	...	...	...	...	...	...
Semipecten forbesianus	...	...	...	...	...	...	...	...	+	...

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Malleus anatinus	...	...	...	...	...	...	...	...	+	...
Vulsella rugosa	...	...	...	...	...	...	...	...	...	...
Electroma ala-corvi	...	...	...	...	+	...	...	...	+	...
,, *zebra*	...	...	...	...	...	...	...	...	...	+
Melina perna	...	...	...	...	...	...	...	...	...	...
Pinna muricata	...	...	...	...	...	...	...	...	...	...
,, *nigra*	...	+	...	...	+	...	...	...	+	+
,, *saccata*	+	...	+	+	+	...	...	...	+	+
,, *serrata*	...	...	...	...	...	...	...	...	...	...
Modiola arborescens	...	...	...	...	...	...	...	...	+	...
,, *auriculata*	+	...	...	+	+	...	...	...	...	+
,, *flavida*	...	...	...	...	...	...	...	...	+	...
Lithodomus cinnamominus	+	...	...	+	+	...	+	...	+	...
,, *gracilis*	...	...	...	...	...	...	...	...	+	...
,, *malaccanus*	...	...	...	...	...	...	...	...	+	...
,, *nasutus*	...	...	...	...	...	...	...	...	...	...
,, *teres*	+	...	+	+	...	...	...	...	+	...
Modiolaria argentea	...	...	...	...	...	...	...	...	...	...
Septifer bilocularis	+	...	+	+	...	...	+	...	+	+
Arca maculata	...	...	...	...	...	...	...	...	+	+
,, *imbricata*	...	...	...	...	+	...	...	...	+	...
,, *clathrata*	...	...	...	...	+	...	...	...	+	...
,, *urypygmelana*	+	+	...	...	+	...	...	...	+	+
,, *antiquata*	...	...	...	...	+	...	...	...	...	+
,, *rhombea*	...	...	...	...	...	...	+	...	+	...
,, *symmetrica*	...	...	...	...	...	...	...	...	+	...
,, *domingensis*	...	...	...	...	+	...	...	...	+	...
,, *lacerata*	+	...	...	...	+	...	...	...	+	...
,, *lima*	...	...	...	...	+	...	...	...	+	...
,, *tenella*	...	...	...	...	...	...	...	...	+	...
Mytilicardia variegata	+	...	+	+	+	+	+	...	+	...
Galeomma formosa	...	..	...	...	...	...	...	...	...	+
Thyreopsis coralliophila	+	...	...	...	...	...	...	...	...	...
Tridacna cumingii	...	...	...	...	...	...	...	...	+	...
Cardium leucostoma	+	...	...	...	+	...	+	...	+	...
,, *nebulosum*	...	...	...	...	...	...	...	...	...	...
,, *maculosum*	...	...	...	...	+	...	+	...	+	...
,, *levisulcatum*, n. sp.	...	...	...	...	...	...	...	...	...	...
,, *sueziense*	...	...	...	...	+	...	...	...	...	...
,, *lobulatum*	...	...	...	...	...	...	...	...	+	...
,, *australe*	+	...	...	...	+	...	+	+	+	...
,, *biradiatum*	...	...	...	...	...	...	+	...	+	...
,, *victor*	+	...	...	...	...	...	...	...	+	...

	Mauritius	Madagascar	Amirantes	Seychelles	Red Sea and Gulf of Aden	Persian Gulf	Ceylon	Andaman Is.	Malaysia	E. Australia to Polynesia
Cardium fornicatum	...	...	...	...	+	...	...	...	+	...
Chama jukesi	...	...	...	...	+	...	...	...	+	...
,, *imbricata*	+	...	...	...	...	...	...	...	...	+
Meiocardia lamarckii	...	...	...	...	...	...	...	...	+	...
Trapezium oblongum	+	...	...	...	...	...	...	...	+	...
Venus reticulata	...	...	...	...	+	...	+	...	+	...
,, *marica*	+	...	...	...	...	...	...	...	+	...
,, *recognita*	...	..	...	...	...	...	...	...	+	...
,, *toreuma*	...	...	...	...	...	...	...	...	...	+
Circe scripta	...	...	...	+	+	...	+	...	+	...
Lioconcha picta	...	...	...	...	+	...	...	...	+	...
,, *sulcatina*	...	...	...	...	...	...	...	...	+	...
Petricola lapicida	+	...	...	...	+	...	...	...	+	...
Psammobia rugulosa	...	...	...	...	...	...	...	...	+	...
,, *pulcherrima*	...	...	...	...	...	...	...	...	+	+
Asaphis deflorata	+	+	...	+	+	...	...	...	+	+
Rocellaria gigantea	...	...	...	...	...	...	...	...	...	...
,, *mytiloides*	+	+	...	...	...	...	...	...	+	...
Paphia trigona	...	...	...	...	...	...	...	...	...	...
,, *glabrata*	...	...	+	+	+	...	...	...	+	...
Lucina divergens	...	...	...	...	+	...	...	...	+	...
,, *punctata*	+	...	+	+	...	...	...	...	+	+
,, *dalliana*	...	...	...	...	...	...	...	...	...	...
Cryptodon globosus	+	...	...	...	+	...	...	..	...	...
Tellina elegans	+	...	...	+	...	...	...	...	...	...
,, *crucigera*	...	...	...	...	+	...	...	...	+	...
,, *rastellum*	...	...	...	+	+	...	...	...	+	...
,, *rhomboides*	+	...	...	...	...	..	...	...	+	...
,, *dispar*	...	...	...	...	...	...	...	...	+	+
,, *robusta*	+	...	...	+	...	...	...	...	+	+
,, *rugosa*	+	...	...	...	+	...	+	...	+	+
,, *scobinata*	...	...	...	...	+	...	...	...	+	+
,, *carnicolor*	...	...	...	...	...	...	...	...	+	+
,, *verrucosa*	...	...	...	...	...	...	...	...	+	...
Semele jukesi	...	...	...	...	...	...	...	...	+	...
Cuspidaria elegans	...	...	...	...	...	...	...	...	+	...

It has been noticed in other groups of animals that the specimens collected at the Maldives have a tendency to be smaller than those found upon the shores of the mainland and Ceylon. This peculiarity also to a certain extent is noticeable among the Mollusca, or, at all events, the representatives of many species are small in comparison with the larger dimensions they often attain.

No attempt has been made to give full synonymy or many references to illustrations, but it has been thought advisable, in each case, to quote a figure or a description, so as to show what species was really referred to. This is necessary in some instances where an author's species has been differently interpreted by his successors, as, for example, in the case of *Strombus auris-dianae* of Linné, where Reeve's and Deshayes' view of this species is quite the reverse of that held by Sowerby.

In the account of the numerous species hereafter mentioned the localities where they were obtained are referred to under numbers only which are explained in the following list of stations.

I.	Addu Atoll,	5—40 fathoms
II.	Suvadiva Atoll,	5—44 „
III.	Haddumati Atoll,	3—40 „
IV.	Kolumadulu Atoll,	1—40 „
V.	S. Nilandu Atoll,	1—36 „
VI.	Mulaku Atoll,	1—40 „
VII.	Felidu Atoll,	1—35 „
VIII.	S. Male Atoll,	1—30 „
IX.	Hulule Island,	1—6 „
X.	N. Male Atoll,	1—35 „
XI.	Goidu Island,	On reef
XII.	Mahlos Atoll,	4—24 „
XIII.	Fadifolu Atoll,	2—23 „
XIV.	Miladumadulu Atoll,	3—28 „
XV.	Minikoi,	On reef and 5—7 fathoms.

[The editor regrets that the dimensions of the whole work on the Fauna of the Maldives and Laccadives have made it necessary to follow the method adopted by many publications in placing the list of literature at the end with reference numbers to the same in heavy black type, and more especially since Mr Smith had most carefully prepared his manuscript with the references in full under each species. He also deeply regrets that the special geographical distribution given, in the manuscript, with each form, and which entailed considerable research into conchological literature, has, for the same reason, had to be omitted. Roman numerals in italics refer to the volume of the work quoted. Ed.]

Family ACTAEONIDAE.

1. **Solidula glabra,** Reeve, var. **37,** *XV.* (*Solidula sulcata*, Pilsbry (nec *Voluta sulcata*, Gmelin), **34,** *XV.*) X, XV.

In my opinion this is not the *Voluta sulcata* of Gmelin, as stated by Martens and Pilsbry. The name *sulcata* practically proves this, and a reference to the grooved figures in the Conchylien-Cabinet upon which the species was founded also shows that it is quite distinct from Reeve's *Tornatella glabra.* Moreover Martini (*Conch. Cab.* vol. II. p. 124) described his shell as being "*tief gefurchet,*" a character not at all applicable to the present species but admirably suiting the well-known *Solidula solidula* (Linn.) with which, in my opinion, the *V. sulcata* is synonymous.

The specimens from the above stations are small and slender.

2. **Solidula nitidula**, Lamk. **34,** *XV.* IX, XV.

3. **Solidula solidula**, Linn., var. **34,** *XV.* VIII.

A single specimen, pure white, with only a few grey dots upon the ridges near the outer lip.

4. **Solidula tessellata,** Reeve, **34,** *XV.* IX.

Family BULLIDAE.

5. **Bulla ampulla,** Linn. **34,** *XV.* II, IX, XI.

Family AKERIDAE.

6. **Volvatella cincta,** Nevill, **34,** *XV.* XV.

Family SCAPHANDRIDAE.

7. **Atys cylindrica,** Helbling, **34,** *XV.* II.

8. **Atys naucum,** Linn., **34,** *XV.* II, III, V, IX.

9. **Atys succisa,** Ehrenberg, **40,** *a*, *XVII.*, **1,** *c.* XV.

It is uncertain whether the shells figured by Adams and Sowerby truly represent Ehrenberg's species, but it is equally certain that they do not belong to *A. cylindrica* as stated by Pilsbry. The latter has made a curious mistake in connection with *A. succisa* (*Man. Conch.* vol. XV. p. 267). He states, "There is the trace of a median gibbosity," whereas Ehrenberg distinctly says it is absent, "gibberis vestigium in zona media deest."

Family OXYNOEIDAE.

10. **Oxynoe delicatula,** Nevill, **34,** *XV.* XV.

Family PHILINIDAE.

11. **Cryptophthalmus minikoiensis,** n. sp. (Pl. XXXV. figs. 1, 2). XV.

Animal corpore oblongo, angusto; discus capitalis parte corporis reliqua brevior, bipartitus, parte anteriori scutiformi, antice bimarginata, truncata, postice angustata, bilobata, parte posteriori postice

truncata, ad latera carinata et lamellata; pes infra orem leviter sinuatus, ad angulos rotundatus, extensionibus lateralibus semicircularibus, sed in exemplo singulo supra tergum reflexis; testa minima, ad extremitatem corporis posticam posita, cute tenuissima tecta, tenuis, semipellucida, supra convexa, semiconvoluta, postice acuminata, striis incrementi tenuibus sculpta; branchiae plumiformes, multilamellatae, sensim versus extremitatem attenuatae, infra testam sitae. Longit. tota 17 millim. Discus capitalis 7 longus, 4 latus. Diam. lobis pedis expansis 12 millim. Testa 4 longa, $2\frac{1}{3}$ lata.

Closely allied to *C. smaragdinus*, Leuckart, and differing only in the form of the shell. This is exactly the same as that erroneously figured by H. and A. Adams in the *Genera of Recent Mollusca*, vol. III. Pl. LVIII, figs. 3 *a*, 3 *b*, as *Chelidonura hirundinina* of Quoy and Gaimard. A comparison of these figures with those of Leuckart[1] and Ehrenberg[2] at once shows the considerable difference in form.

The shell of *Crypt. luteus*, Quoy and Gaimard, is more like that of the present species, but the short folds on each side of the head-shield do not appear to be present in that species, at all events they are not referred to by the authors. The most remarkable character in this species consists in the structure of the cephalic disc. It is, as it were, in two parts, the one superimposed upon the other. The anterior portion is shield-shaped, being broad, truncate, and double-edged in front, and narrowed behind. The converging sides are not, however, united posteriorly, but form very small lobes, attached to the hinder portion of the disc. The latter is squarely truncate behind, keeled at the sides, and exhibits beneath the carinate margins about fifteen short oblique lamellae. This is a very striking feature, and occurring in *C. smaragdinus*, makes one doubtful whether the present species, although the shell is very different, is really specifically distinct.

Family CONIDAE.

12. **Conus arenatus,** Hwass. **37,** *I.* VIII, IX, XI, XII, XIV, XV.

13. **Conus betulinus,** Linn. **37,** *I.* (*C. medusa*, Gmelin, **16**) IX, XI.

14. **Conus catus,** Hwass. **37,** *I.* (var. = *C. discrepans*? Sowerby, **40,** *a*, var. = *C. adansoni*, Reeve (now Lamk.), **37,** *I.*, var. = *C. nigropunctatus*, Sowerby, **40,** *b*, *III.*) IX, XV.

15. **Conus ceylonensis,** Hwass. **37,** *I.* (var. = *C. pusillus*, Chemnitz, **37,** *I.*, var. = *C. nanus*, Broderip, **37,** *I.*) IX.

16. **Conus distans,** Hwass. **37,** *I.* (*C. mennonitarum coronatus*, Chemnitz, **9**) IX.

17. **Conus eburneus,** Hwass. **37,** *I.* IX, XII, XV.

18. **Conus ermineus,** Born. **40,** *b*, *III.* (*C. lithoglyphus*, Meuschen, **37,** *I.* *C. orleanus*, Bolten, **30,** var. = *C. lacinulatus*, Kiener, **23,** var. = *C. carpenteri*, Crosse, **11,** *a*) IX.

19. **Conus flavidus,** Lamarck. **37,** *I.* (*C. maltzanianus*, Weinkauff, **43,** var. *granulata* = *C. frigidus*, Reeve, **37,** *I.*, var. = *C. neglectus*, Pease, **31,** *b*) XV.

20. **Conus generalis,** Linn. **37,** *I.* (var. = *C. maldivus*, Hwass. **37,** *I.*, var. = *C. monile*, Hwass. **37,** *I.*, var. = *C. bayani*, Jousseaume, **22,** jun. = *C. spirogloxus*, Deshayes, **40,** *b*, *XII.*) XIV.

21. **Conus glans,** Hwass. **37,** *I.* (var. = *C. tenuistriatus*, Sowerby, **40,** *b*, *III.*, var. = *C. fabula*, Sowerby, **37,** *I.*, var. = *C. scabriusculus*, Chemnitz, **9**) IX.

22. **Conus hebraeus,** Linn. **37,** *I.* (var. = *C. vermiculatus*, Lamarck; var. = *C. chaldaeus*, Bolten, **30**) IX.

[1] See Pilsbry, *Man. Conch.* vol. XVI. Pl. VI. figs. 33–34.

[2] See Pilsbry, *l.c.* fig. 32.

23. **Conus lividus,** Hwass. **37,** *I.* (var. = *C. citrinus,* Gmelin, **40,** *b, III.,* var. = *C. sanguinolentus,* Quoy and Gaimard, **35,** var. = *C. maurus,* Gray? **18,** *b*) IX, XI.

24. **Conus miles,** Linn. **37,** *I.* IX.

25. **Conus minimus,** Linn. **37,** *I.* (*Conus coronatus,* Dillwyn (non Gmelin), **43.** *C. barbadensis,* Hwass. **40,** *b, III. C. aristophanes* (Duclos?), **40,** *b, III.*) I, XV.

26. **Conus nussatella,** Linn. **37,** *I.* (*C. terebra,* Chemnitz (nec Born), **9**). IX.

27. **Conus pennaceus,** Born, **37,** *I.* IX, XI.

C. praelatus, Hwass, *C. rubiginosus,* Hwass, *C. episcopus,* Hwass, *C. omaria,* Hwass, *C. magnificus,* Reeve, *C. elisae,* Kiener, *C. racemosus,* Sowerby, and *C. madagascariensis,* Sowerby, may be regarded as varieties of this species.

28. **Conus quercinus,** Linn. **37,** *I.* (*C. buxeus,* Link, **30.** *C. ponderosus,* Beck, **6**). II.

29. **Conus consors,** var. **40,** *b, III.* (var. = *C. innexus,* A. Adams, **I.** *b*) I.

With this species, besides *C. innexus,* I also associate, as varieties, *C. anceps,* A. Adams and *C. daullei,* Crosse.

The single specimen from Addu atoll differs from the typical form of the variety *innexus* in being almost entirely white, and of a slightly more slender form. It is clothed with a thinnish greyish periostracum and the upper whorls of the spire are finely coronated and of a lilac tint.

30. **Conus tendineus,** Hwass. **40,** *I.* IX.

31. **Conus tessellatus,** Born. **37,** *I.* IV, V, IX, XIV.

32. **Conus textile,** Linn. **37,** *I.* IX.

The variation in this species is most remarkable, and although we can recognise typical examples of the many named forms, personally I have not been able to accept as distinct *species* the following:—*C. vicarius,* Lamarck, *C. verriculum,* Reeve, *C. textilina,* Kiener, *C. tigrinus,* Sowerby, *C. corbula,* Sowerby, *C. scriptus,* Sowerby, *C. panniculus,* Lamarck, *C. canonicus,* Hwass, *C. rubescens,* Bonnet, *C. legatus,* Lamarck, *C. paulucciae,* Sowerby, *C. archiepiscopus,* Hwass, and *C. abbas,* Hwass.

33. **Conus tulipa,** Linn. **37,** *I.* (var. = *C. obscurus,* Humphreys, **37,** *I,* jun. = *C. borbonicus,* Adams, **2, 42**). IX, XI, XV.

34. **Conus zonatus,** Hwass. **37,** *I.* IX.

Family TEREBRIDAE.

35. **Terebra maculata,** Linn. **37,** *XII.* IX, XI, XV.

36. **Terebra argus,** Hinds, **37,** *XII.* (*Terebra nebulosa,* Kiener, **23**). IX.

37. **Terebra dimidiata,** Linn. **37,** *XII.* IX.

38. **Terebra oculata,** Lamarck, **37,** *XII.* IX.

39. **Terebra subulata,** Linn. **37,** *XII.* XI.

40. **Terebra crenulata,** Linn. **37,** *XII.* XV.

Buccinum varicosum, Gmelin, *B. luteolum,* Martyn, are synonyms and *T. fimbriata,* Deshayes, and *T. interlineata,* Deshayes, I regard as varieties of this species.

41. **Terebra cingulifera,** Lamarck, **37,** *XII.* (*Buccinum succinctum*, Gmelin, **16.** *T. punctulata*, Sowerby, **40,** *c.* *T. punctatostriata*, Gray, **18,** *a.* *T. pallida*, Deshayes, **12,** *b.* *T. chinensis*, Deshayes, **12,** *d*). IX, X, XII.

42. **Terebra babylonia,** Lamarck, **37,** *XII.* XIV.

43. **Terebra monile,** Quoy and Gaimard, **37,** *XII.* II.

44. **Terebra (Myurella) undulata,** Gray, var. **37,** *XII.* (*T. approximata*, Deshayes, **12,** *d*). II, XIV.

45. **Terebra (Myurella) affinis,** Gray, **37,** *XII.* (*T. striata*, Quoy and Gaimard, **34**). IX, X, XII, XIII, XV.

46. **Terebra (Myurella) columellaris,** Hinds, **37,** *XII.* VIII, X, XII.

47. **Terebra (Myurella) bruguieri,** Deshayes, **37,** *XII.* (*T. hindsii*, Deshayes, **12,** *b*). II.

48. **Terebra (Myurella) amoena,** Deshayes, **37,** *XII.* (*T. andamanica*, Melvill and Sykes, **39**). VII.

A comparison of the types of the above-named species shows that they are merely different stages of growth of one and the same form.

49. **Terebra (Myurella) violascens,** Hinds, var. **20,** *b*, **37,** *XII.* II, IV, VI.

The specimens from the above stations are not typical and vary *inter se.* None are of a violet tint, but whitish or yellowish. The shell described by Reeve had the whorls undivided by a groove or punctured depression, whereas Hinds described the type with whorls "supernè lineâ impressâ obsoletè cinctis." The Maldive specimens agree with the type in this respect. *Terebra exigua*, Deshayes, and *T. polygyrata*, Deshayes, are probably only slight varieties.

50. **Terebra (Hastula) lanceata,** Linn. **37,** *XII.* (var. *penicillata*, Hinds, **37,** *XII*, var. *venosa*, Hinds, **37,** *XII.*). XV.

The specimen from Minikoi (station XV.) belongs to the variety *penicillata.*

51. **Terebra celidonota,** Melvill and Sykes, **29.** XIV.

Family PLEUROTOMIDAE.

52. **Pleurotoma armillata,** Reeve, **37,** *I.* VI.

53. **Pleurotoma bijubata,** Reeve, **37,** *I.* VIII.

54. **Pleurotoma tigrina,** Lamarck, **37,** *I.* VI, IX, XIV.

55. **Drillia (Clavus) exasperata,** Reeve (*Pleurotoma exasperata*, Reeve, **37,** *I.*). II.

56. **Clathurella robillardi,** Adams, **41,** *VI.* XIV.

57. **Daphnella saturata,** Reeve, **37,** *I.* II, VI.

Family OLIVIDAE.

58. **Oliva erythrostoma,** Lamarck (var. *ponderosa*, Reeve, **37,** *VI.*). IV, VI, IX, XI.

Apparently browsing on a black crinoid (Gardiner).

Family HARPIDAE.

59. **Harpa ventricosa,** Linn. **37,** *I.* IX.

60. **Harpa minor,** Lamarck, **37,** *I.* IX.

A specimen captured by Mr Gardiner at station I. has the hinder portion of the foot detached. Judging from the large size of the separated portion, the animal apparently divested itself of it, being unable to withdraw this bulky appendage within the shell. Or, may it not be cast off as a peace offering to any fish or other predatory creature who attacks the helpless Mollusc?

Family MARGINELLIDAE.

61. **Marginella picturata,** Nevill, var. Pl. XXXV. figs. 3, 4 (*M. picturata*, Weinkauff, **43**). X.

The two specimens which I believe to be a variety of this species differ from the type in having the outer lip strongly denticulate within, in one example the denticles numbering thirteen, in the other only nine. Both are of a fleshy tint, with two white narrow zones with reddish-brown spots upon the penultimate whorl, and three upon the last, one at the suture, one at the shoulder, and one towards the base, all terminating upon the thickened labrum in a red spot. Between the second and third zones there are three or four transverse lines of pinkish red colour and the extreme tip of the spire is also reddish. The brown spots upon the narrow white zones are small and might be described as cross lines rather than spots.

Family MITRIDAE.

62. **Mitra episcopalis,** Linn. **40,** *b, IV.* XI.

63. **Mitra pontificalis,** Lamarck, **40,** *b, IV.* IX.

64. **Mitra tessellata,** Martyn, **40,** *b, IV.* IX.

65. **Mitra adusta,** Lamarck, var. **40,** *b, IV.* IX.

One specimen of a uniform rich brown colour and without any crenulations beneath the sutures.

66. **Mitra digitalis** (Chemnitz), Dillwyn, **40,** *b, IV.* IX.

67. **Mitra (Scabricola) crenifera,** Lamarck, **40,** *b, IV.* IV.

68. **Mitra (Scabricola) scabriuscula,** Linn. **40,** *b, IV.* XI.

69. **Mitra (Scabricola) variegata,** Reeve, **40,** *b, IV.* II.

70. **Mitra (Chrysame) cucumerina,** Lamarck, **40,** *b, IV.* IX, XIII, XV.

71. **Mitra (Cancilla) filaris,** Linn. **41,** *IV.* (*M. filosa*, Born, **40,** *b, IV.*) XI.

72. **Mitra (Cancilla) insculpta,** A. Adams, var. **40,** *b, IV.* V, VI.

73. **Mitra (Cancilla) interlirata,** Reeve, **40,** *b, IV.* II.

74. **Mitra (Strigatella) literata,** Lamarck, **40,** *b, IV.* IX, XI, XV.

75. **Mitra (Strigatella) acuminata,** Swainson, **40,** *b, IV.* I, IX, XI.

76. **Mitra (Strigatella) auriculoides,** Reeve, var. **40,** *b, IV.* IX.

The two specimens obtained by Mr Gardiner differ considerably from all the figures given of this species. They are much more slender, and the upper part of the shell above the white zone

is white, blotched with dark chestnut. The lower part of the body-whorl is minutely white-dotted. Intermediate forms connecting this with the type occur in the British Museum collection. Length, 17 mm., diam. 7 mm.

77. **Mitra (Costellaria) exasperata,** Gmelin, **40,** *b, IV.* (var. = *M. arenosa*, Lamarck, **40,** *b, IV.*) VII, VIII, IX, X, XII, XIV, XV.

The two specimens from station XIV. are variations of the form *arenosa*, differing from normal examples in being almost entirely white, with only one or two faint zones below the middle of the body-whorl.

78. **Mitra (Costellaria) sculptilis,** Reeve, **37,** *II.* II, V, X.

79. **Mitra (Costellaria) acupicta,** Reeve, **40,** *b, IV.* V.

80. **Mitra (Costellaria) armigera,** Reeve, var. **37,** *II.* IX.

A single specimen only of this species was obtained. It differs from the type in being whiter, with a thread-like brown line round the middle of the upper whorls and three on the last. The locality of the type is unknown. *M. turrigera*, Reeve, is closely allied, but more sculptured between the costae.

81. **Mitra (Costellaria) deshayesii,** Reeve, **40,** *b, IV.* X.

82. **Mitra (Costellaria) angustissima,** n. sp. (Pl. XXXV. fig. 5). V.

Testa gracillima, elongato-fusiformis, pallide fuscescens, ad partem anfractuum superiorem albida, fusco maculata, et circa medium anfr. ultimi maculis subquadratis notata; anfractus circiter 10, superiores subgradati, fere plani, caeteri leviter convexiusculi, costis numerosis (circiter 28) gracilibus instructi, et sulcis spiralibus inter costas punctatis (in anfr. penult. 7, in ultimo 12—13) sculpti, ultimus antice circa caudam sulcis obliquis fortioribus haud punctatis ornatus; apertura parva, angusta; longit. totius $\frac{1}{3}$ paulo superans; columella plicis quinque obliquis instructa, callo tenui induta; labrum tenue. Longit. $12\frac{1}{2}$ mm., diam. 4. Apertura 5 longa, $1\frac{1}{3}$ lata.

Remarkable for its very slender form and the punctate striae between the costellae. The folds on the columella correspond to the oblique ridges between the sulci on the cauda of the body-whorl. These ridges are spotted with pale brown.

83. **Cylindra sinensis,** Reeve, **40,** *b, IV.* VI.

Family FASCIOLARIIDAE.

84. **Latirus craticulatus,** Linn. (*Turbinella craticulata*, Reeve, **37,** *IV.*) IX.

85. **Latirus fastigium,** Reeve (*Turbinella fastigium*, Reeve, **37,** *IV.*) XII.

86. **Peristernia nassatula,** Lamarck (*Turbinella nassatula*, Reeve, **37,** *IV.*) IX.

87. **Leucozonia smaragdula,** Linn. (*Turbinella smaragdula*, Reeve, **37,** *IV.*) IX, XI, XIII.

Family TURBINELLIDAE.

88. **Cynodonta cornigera,** Lamarck (*Turbinella cornigera*, Reeve, **37,** *IV.*) Maldives.

Family BUCCINIDAE.

89. **Engina mendicaria,** Lamarck (*Ricinula mendicaria,* Reeve, **37,** *III.*) XI.

90. **Engina bonasia,** Martens (*Plicatella* (*Peristernia*) *bonasia,* Martens, **26**). IX.

91. **Engina rawsoni,** Melvill (*Sistrum rawsoni,* Melvill, **27,** *a*). V.

The columella is described as "simplice," but all the specimens examined, including the type, exhibit a thin circumscribed callosity, with a small transverse tubercle at the upper end, and a few anteriorly. All also have a pale peripheral zone, and some of the costae are whitish. In one of the Maldive specimens, white is the predominating tint; on the contrary, a second example is almost entirely of a rich brown colour, excepting the whitish zone round the middle of the body-whorl, which is rather more contracted and produced anteriorly than usual, the canal, in consequence, appearing a little longer.

92. **Phos roseatus,** Hinds, **40,** *b, III.* II, IV, V, VI, VII.

93. **Phos textilis,** A. Adams, **40,** *b, III.* V, XIII.

The specimens from the above localities are considerably smaller than the type from the Philippine Islands but do not offer any tangible differences in other respects. The protoconch is large and consists of three smooth glossy convex yellowish whorls. The normal volutions may vary from four-and-a-half to five-and-a-half.

Family NASSIDAE.

94. **Nassa bifaria,** Baird, var. **5, 39,** *f.* II, IV, V, VII, X.

The Maldive specimens belong to the same variety as those from the Andaman Islands which I recorded and figured at the above reference. Tryon in his absurd craze for "lumping" considered this species "a stumpy variety" of *N. hirta,* Kiener, a species with which it has in fact but slight resemblance, differing in size, colour and sculpture.

95. **Nassa marratii,** Smith, **39,** *e, f.* XI.

Two specimens were obtained agreeing with the type excepting in their larger size, being 19 mm. in length, like the Andaman examples figured in the *P. Z. S.*

96. **Nassa monile,** Kiener, **37,** *VIII.* XI.

97. **Nassa stigmaria,** A. Adams, **37,** *VIII.* V, XII, XV.

98. **Nassa echinata,** A. Adams, **37,** *VIII.* IX, X, XII, XV.

99. **Nassa glans,** Linn. **37,** *VIII.* III.

100. **Nassa granifera,** Kiener, **37,** *VIII.* IV, VIII, X, XIII, XV.

101. **Nassa maldivensis,** n. sp. (Pl. XXXV. figs. 6—8). VIII, IX, XII.

Testa *N. algidae*[1] similis, sed concolor, albida, anfractu ultimo majori; lirae aperturae circiter 12 et columellae rugae validae. Longit. 25 mm., diam. 15. Apertura cum labro 15 longa, 7 lata.

var. *a.* VII. Testa minor, anfractu ultimo costato. Longit. 20 mm., diam. 11.

Shell ovate, turreted, white; whorls $6\frac{1}{2}$ gradate, upper ones costate, the costae nodose at the upper end through being traversed by a depression or groove, gradually dying out so that the

[1] *Nassa algida,* Reeve, *Con. Icon.* vol. VIII. figs. 145 *a, b.*

body-whorl is quite smooth excepting towards the labrum where a few sulci parallel with it are sometimes visible and four or five rather coarse grooves encircle the base. The outer lip is sharp at the edge with four or five denticles anteriorly thickened and lirate within. Lirae twelve in number, produced within the aperture, thread-like, not reaching to the edge of the lip. Columella transversely lirate, furnished with a free-edged callosity. The operculum is yellowish, unguiform, with a terminal nucleus, and serrated on each side towards the apex.

102. **Nassa mulukuensis,** n. sp. (Pl. XXXV. figs. 9, 10). VI.

Testa *N. maldivensi* similis, sed gracilior, anfractibus superioribus spiraliter liratis, operculo diverso instructa.

Longit. 24 mm., diam. 12. Apertura $12\frac{1}{2}$ longa, 6 lata.

Shell elongate-ovate, turreted, whitish, with a few dots and spots of a reddish colour on the upper edge of the whorls, especially on the dorsal margin of the body-whorl. Whorls 9, the three apical smooth, glassy, the four following obliquely costate and transversely sulcate, the grooves causing the costae to be somewhat nodulous. The last two whorls are smooth, excepting the subsutural row of nodules and a few sulci parallel with the labrum and around the lower part of the body-whorl. The labrum, lirae within and the columellar callosity are as in *N. maldivensis.*

The operculum, however, is quite different from that of the species referred to, being ovate, concentric, with a central nucleus, and having only a few serrations on one (the outer) side.

103. **Nassa subtranslucida,** n. sp. (Pl. XXXV. fig. 11). V.

Testa elongata, turrita, subpellucida, nitens, albida, maculis et lineis dilute fuscis irregulariter picta; anfractus 7, superiores tres laeves, convexiusculi, circa medium carinati, caeteri gradati, convexiusculi, longitudinaliter costati, costis laevibus, crassiusculis, quam interstitiis latioribus, in interstitiis trasversim striati, ultimus circa basim fortiter sulcatus et nodose liratus, cauda alba oblique sulcata instructus; apertura intus alba, longit. totius $\frac{1}{2}$ haud aequans; labrum extra valde incrassatum, album, maculis duabus fuscis ornatum, intus tenuiter liratum; columella arcuata, callo tenui, antice denticulum formante, induta.

Longit. 8 mm., diam. 4.

This is a shining semipellucid species, rather strongly costate for its size. The last three or four ribs behind the labrum are obsolete inferiorly, and all are subnodose below the suture, through being crossed by a shallow groove. The colour-markings are irregularly disposed, but the principal spots are upon the upper extremities of some of the costae and at the middle and base of the body-whorl.

104. **Nassa disparilis,** n. sp. (Pl. XXXV. fig. 12). V.

Testa minima, ovata, alba, lineis rufis duabus circa anfract. ultimum cincta; anfractus 7—8, superiores tres convexiusculi, laeves, politi, circa medium carina filiformi instructi, caeteri longitudinaliter oblique costati (costis in anfr. penult. et antepenult. crassis, circiter 8, in ultimo gracilioribus, circiter 16, supra nodosis) inter costas spiraliter distincte sulcati; apertura parva, longit. totius $\frac{2}{5}$ adaequans; labrum extra varice albo crasso transversim striato instructum, intus liris 9, haud ad marginem productis, munitum; columella callo circumscripto induta, arcuata, transversim tuberculata.

Longit. $7\frac{1}{2}$ mm., diam. 4.

Only a single example is in the collection. It is remarkable for the stoutness and small number of the costae upon the penultimate and antepenultimate whorls in comparison with those upon the last. The upper extremities are cut across by a distinct groove, thus forming a row of nodules

below the suture. Of the two reddish lines upon the last whorl, the upper one is around the middle, and the other at the base.

105. **Nassa ecstilba,** Melvill and Standen, **28,** *a.* XIV, XV.

Family COLUMBELLIDAE.

106. **Columbella conspersa,** Gaskoin, **37,** *XI.* II.

A single typical specimen.

107. **Columbella flava,** Bruguière, **37,** *XI.* I, X.

108. **Columbella jaspidea,** Sowerby, **37,** *XI.* **40,** *b, I.* IX.

Only a single specimen was obtained. Probably *C. plicaria,* Montrouzier (*Journ. Conch.* vol. x, p. 234, pl. IX, fig. 3, 1862) is a variety of this species. The specimen figured by Reeve is not mottled or spotted like the type, the latter agreeing in this respect with *C. plicaria.*

109. **Columbella galaxias,** Reeve, **37,** *XI.* XV.

110. **Columbella turturina,** Lamarck, **37,** *XI.* IX, XV.

111. **Columbella varians,** Sowerby, var. **40,** *b, I.* **37,** *XI.* IX.

A single whitish example with the transverse striae indistinct so that the surface is rather smooth.

Family MURICIDAE.

112. **Murex ternispina,** Lamarck, **37,** *III.* I, VI, X, XIII.

113. **Murex haustellum,** Linn. **37,** *III.* VI, X.

114. **Murex (Pteronotus) tripterus,** Born. **37,** *III.* V.

115. **Murex (Chicoreus) aculeatus,** Lamarck, **37,** *III.* V, XII.

116. **Murex (Chicoreus) adustus,** Lamarck, **37,** *III.* V, VII.

117. **Murex (Chicoreus) rubiginosus,** Reeve, **37,** *III.* IX.

118. **Murex (Chicoreus) ramosus,** Linn. **37,** *III.* IX.

119. **Murex (Ocinebra) salmoneus,** Melvill and Standen, **28,** *b.* (*Murex pumilus,* A. Adams, **1,** *b.* **40,** *b, IV.* **39,** *g.*) XII.

The name *pumilus,* A. Adams, was preoccupied by Broderip many years previously, hence the employment of the name *salmoneus.* I think there is little doubt that Messrs Melvill and Standen redescribed this species, for examination of the types of both forms shows that they are the same species. The single example from the Maldive Islands is dirty whitish, but, being a dead shell, and occupied by a *Pagurus,* it probably has lost the usual rose-colour.

120. **Murex (Ocinebra) pleurotomoides,** Reeve, **37,** *III.* II.

Three specimens rather smaller than the type, with the anterior canal stained with brown and a pale brown zone round the middle of the body-whorl. The lirae within the labrum are about six in number, and the tubercles on the columella, three or four. The posterior sinus, at the upper end of the outer lip, seems to be a constant feature.

121. **Murex (Ocinebra) submissus,** n. sp. (Pl. XXXV. fig. 13). XII.

Testa minima, ovata, rimata, supra acuminata, albida, lineis interruptis nigro-fuscis cincta; anfractus $6\frac{1}{2}$, superiores tres laeves, convexi, caeteri supra concave declives, costis longitudinalibus octo et liris spiralibus supra costas elatis (in anfr. penult. 2, in ultimo 8—9) instructi, incrementi lineis tenuissimis striati, ultimus in medio convexiusculus, antice contractus; apertura intus flavescens; labrum extra incrassatum, intus liris brevibus sex haud ad marginem productis munitum; columella sinuosa, callo tenui reflexo flavescente induta, in medio prominens, tuberculis parvis 3—4 munita; canalis anterior obliquus, recurvus.

Longit. $8\frac{1}{2}$ mm., diam. 5.

The dark brown transverse lines, about six or seven upon the last whorl, are interrupted between the costae, and falling upon the raised lirae, the ribs appear to be crossed by coloured tubercles.

The costae are a little oblique and continuous up the spire. The smooth protoconch is marked off from the first normal whorl by a slender varix or thickened lip of its last whorl. The three whorls of which it consists have a yellowish margination beneath the suture.

122. **Purpura armigera,** Lamarck, **37,** *III.* IX.

123. **Purpura bitubercularis,** Lamarck, **37,** *III.* IX.

124. **Purpura hippocastanum,** Lamarck, **37,** *III.* XI, XV.

125. **Purpura pica,** Blainville, **37,** *III.* IX.

126. **Iopas situla,** Reeve (*Buccinum situla*, Reeve, **37,** *III.*) IX.

127. **Iopas sertum,** Bruguière (*Buccinum sertum*, Reeve, **37,** *III.*) I.

128. **Sistrum digitatum,** Lamarck (var. *lobatum*, Blainville; *Ricinula digitata*, Reeve, **37,** *III.*) IX.

129. **Sistrum horridum,** Lamarck (*Ricinula horrida*, Reeve, **37,** *III.*) I, IX.

130. **Sistrum ricinus,** Linn. (*Ricinula arachnoidés*, Reeve, **37,** *III.*) I, IX, XI, XV.

131. **Sistrum tuberculatum,** Blainville (*Ricinula tuberculata*, Reeve, **37,** *III.*) IX.

132. **Sistrum undatum,** Chemnitz (*Ricinula fiscellum*, Reeve, **37,** *III. Sistrum undatum*, partim, Tryon, **41,** *II.*) VIII, X, XV.

133. **Sistrum elatum,** Blainville (*Ricinula spectrum*, Reeve, **37,** *III.*) II, IX, XI.

In the two fresh specimens obtained, the labrum is white, but the interior of the aperture is yellowish.

134. **Sistrum spinosum,** A. Adams (*Ricinula chrysostoma*, partim, Reeve, **37,** *III. Ricinula biconica*, partim, Tryon, **41,** *II.*) XIII.

Messrs H. and A. Adams (*Genera Recent Mollusca*, vol. i. p. 130) recognised that Reeve had wrongly identified the *Ricinula chrysostoma* of Deshayes and imposed the name of *spinosus* upon the misunderstood species. The term *spinosus* is applicable to fig. 12 *b* rather than to 12 *a*, which represents the *Ricinula biconica* of Blainville. I think therefore the species *spinosus* should be restricted to the figure 12 *b*. Whether it is conspecific with *S. biconicum* has yet to be proved. Although united by Tryon, at present I am inclined to consider them sufficiently distinct.

135. **Sistrum biconicum,** Blainville (*Purpura biconica*, Kiener, **23.** *Sistrum biconicum*, Tryon, **41,** *II.* *Ricinula chrysostoma*, partim, Reeve, **37,** *III.*) XIII.

136. **Sistrum cavernosum,** Reeve (*Ricinula cavernosa*, Reeve, **37,** *III.*) IX, XV.

137. **Sistrum iostoma,** A. Adams (Pl. XXXV. fig. 14). (*Murex iostomus*, A. Adams, **1,** *a.*) VIII.

This species is allied to *S. spinosum*, but appears to be separable.

138. **Sistrum squamosum,** Pease, **31,** *a.* XI.

The Maldive specimen is quite typical.

139. **Sistrum concatenatum,** Lamarck (*Ricinula concatenata*, Reeve, **37,** *III.*, var. = *Purpura fragum*, Blainville, **23**). IX.

A very variable species in size, form, and colour. Only a single small specimen was obtained at the above station and it most resembles the variety *fragum* as the aperture and labrum are white and not orange red as in the type.

140. **Sistrum decussatum,** Reeve, var. (*Murex decussatus*, Reeve, **37,** *III.*) XIV.

A single very small specimen differing from the type in having a shorter anterior canal, and in the nodules at the upper angle of the whorls being uncoloured and acute. Although adult, only 13 mm. in length.

Family CORALLIOPHILIDAE.

141. **Coralliophila monodonta,** Quoy and Gaimard (*Purpura monodonta*, **23**). II, V, IX, XI, XIII.

142. **Coralliophila neritoidea,** Gmelin (*Purpura violacea*, Kiener, **37,** *III.*) VIII, IX.

143. **Coralliophila suturalis,** A. Adams, **1,** *b* (*C. galea* (partim), **41,** *II.* *Rhizocheilus exaratus*, Pease, **31,** *b*). IX, XV.

144. **Coralliophila squamosissima,** Smith, **41,** *II.* IX.

145. **Leptoconchus ellipticus,** Sowerby (*Magilus ellipticus*, Sowerby, **40,** *a, XVIII.*) XV.

The transverse ribbing usually extends over the greater part of the body-whorl, although, in the description, Mr Sowerby observes that the shell is "spirally slightly ribbed below the middle," as if this were a specific feature. A fine example in the British Museum from the Mauritius is 27 mm. long, and 22 in diameter.

146. **Leptoconchus cumingii,** Deshayes, **12,** *a*, **40,** *a, XVIII.* XV.

The shell figured by Sowerby (*l.c.* fig. 10) as *Magilus globulosus*, I regard as a form of the present species.

Family LOTORIIDAE.

147. **Lotorium chlorostoma,** Lamarck (*Triton chlorostoma*, Reeve, **37,** *II.*) IX, XV.

148. **Lotorium gemmatum,** Reeve (*Triton gemmatum*, Reeve, **37,** *II.*) IX.

149. **Lotorium pyrum,** Lamarck (*Triton pyrum*, Reeve, **37,** *II.*) IX.

150. **Lotorium tuberosum,** Lamarck (*Triton tuberosus*, Reeve, **37,** *II.*) I.

151. **Colubraria ceylonensis,** Sowerby (*Triton ceylonensis*, Reeve, **37,** *II.*) V, XIV.

152. **Colubraria obscura,** Reeve (*Triton obscurus*, Reeve, **37,** *II.*) XIV.

153. **Colubraria bracteata,** Hinds (*Triton bracteatus*, Reeve, **37,** *II.*) IX.

A small form only about 13 mm. in length.

154. **Colubraria digitale,** Reeve (*Triton digitale*, Reeve, **37,** *II.*) IX.

In fresh specimens three rows of pale brownish spots are visible upon the last whorl, one below the suture, one at the middle, and the third below it. These spots form interrupted colour bands, which, however, are only observable in well preserved shells.

155. **Distortrix anus,** Lamarck (*Triton anus*, Reeve, **37,** *II.*) IX.

156. **Ranella bufonia,** Lamarck, **37,** *II.* IX, XV.

157. **Ranella granifera,** Lamarck, **37,** *II.* IX, XI, XIV.

158. **Ranella tuberosissima,** Reeve, **37,** *II.* XIV.

159. **Ranella thomae,** d'Orbigny, **14** (*R. bergeri*, Canefri, **7**). XII.

The single Maldive specimen has the transverse ridges of a blackish brown colour but in other respects agrees very well with the examples cited from the above localities.

160. **Ranella (Lampas) lampas,** Lamarck (*Triton lampas*, Reeve, **37,** *II.*) IX.

Family CASSIDIDAE.

161. **Cassis cornuta,** Linn. **37,** *V.* IX.

162. **Cassis rufa,** Linn. **37,** *V.* IX.

Family DOLIIDAE.

163. **Malea pomum,** Linn. (*Dolium pomum*, Reeve, **37,** *V.*) IX.

164. **Dolium costatum,** Menke, **37,** *V.* IX.

165. **Dolium olearium,** Lamarck, **37,** *V.* XV.

166. **Pirula ficoides,** Lamk. jun.? **23** (*Ficula reticulata*, Reeve (non Lamarck), **37,** *III.*) V, VII.

Family CYPRAEIDAE.

167. **Cypraea arabica,** Linn. (*a.* var. *typica*, **40,** *b, IV.* IX. *b.* var. *eglantina*, Duclos, **40,** *b, IV.* IX. *c.* var. *histrio*, Meuschen, **40,** *b, IV.* IX, XI, XII, XIII. *d.* var. *intermedia*, Gray, **40,** *b, IV.* IX.).

168. **Cypraea argus,** Linn. **37,** *III.* IX.

169. **Cypraea asellus,** Linn. **37,** *III.* IX.

170. **Cypraea caput-serpentis,** Linn. **37,** *III.* IX, XI, XV.

171. **Cypraea carneola,** Linn. **37,** *III.* I, IX, XI.

172. **Cypraea caurica,** Linn. **37,** *III.* IX, XI, XIII.

173. **Cypraea clandestina,** Linn. **37,** *III.* IX.

174. **Cypraea cribraria,** Linn. **37,** *III.* XIV.

175. **Cypraea erosa,** Linn. **37,** *III.* IX, XI, XIII, XV.

176. **Cypraea felina,** Gmelin, var. **37,** *III.* IX, XV.

177. **Cypraea gangrenosa,** Solander, **40,** *b, IV.* X, XII.

178. **Cypraea (Epona) globulus,** Linn. **37,** *III.* XIII.

179. **Cypraea helvola,** Linn. **37,** *III.* VIII, IX.

180. **Cypraea hirundo,** Linn. **37,** *III.* IX, XIII.

181. **Cypraea isabella,** Linn. **37,** *III.* IX, XI.

182. **Cypraea lamarckii,** Gray, **37,** *III.* III, VIII.

183. **Cypraea lynx,** Linn. **37,** *III.* I, IX.

184. **Cypraea mauritiana,** Linn. **37,** *III.* XI.

185. **Cypraea minoridens,** Melvill, **27,** *b,* **39,** *d* (*Cypraea fimbriata,* partim, Sowerby, **40,** *b, IV.*) IX.

186. **Cypraea moneta,** Linn. **37,** *III.* IX, XI, XIII, XIV, XV.

187. **Cypraea poraria,** Linn. **37,** *III.* IX, XI.

188. **Cypraea annulus,** Linn. **37,** *III.* IX.

189. **Cypraea staphylaea,** Linn. **37,** *III.* VII.

190. **Cypraea talpa,** Linn. **37,** *III.* IX.

191. **Cypraea tigris,** Linn. **37,** *III.* IX.

192. **Cypraea vitellus,** Linn. **37,** *III.* IX.

193. **Cypraea walkeri,** Gray, **37,** *III.* II, III, V, VI, XIII.

194. **Cypraea ziczac,** Linn. **37,** *III.* XIII.

195. **Trivia pellucidula,** Gaskoin (*Cypraea pellucidula,* Sowerby, **40,** *b, IV.*) X.

Family STROMBIDAE.

196. **Strombus dentatus,** Linn. (var. *Rüppellii,* Reeve, **37,** *VI.*) I—VI.

197. **Strombus floridus,** Lamk. **37,** *VI.* I, IX, XI, XV.

198. **Strombus gibberulus,** Linn. **37,** *VI.* IX—XII, XIV, XV.

199. **Strombus labiosus,** Gray, **37,** *VI.* V, VI.

200. **Strombus lentiginosus,** Linn. **37,** *VI.* IX.

201. **Strombus guttatus** (Chemnitz), Kiener, **23, 37,** *VI.* V.

202. **Strombus lamarckii,** Gray, **40,** *b, I.* IX.

203. **Pterocera lambis,** Linn. **37,** *VI.* IX.

204. **Pterocera chiragra,** Linn. **37,** *VI.* IX.

205. **Terebellum terebellum,** Linn. (*Terebellum punctatum*, Reeve, **37,** *VI.*) II—VI, X.

Family CERITHIIDAE.

206. **Triforis corrugatus,** Hinds, **20,** *a*, **8.** X.

207. **Triforis elegans,** Hinds, **20,** *a* (*T. picturatus*, Sowerby, **40,** *e*). IX.

I have compared the type of *T. picturatus* with authentic specimens of the present species and have no hesitation in pronouncing them specifically the same. Although Mr Sowerby described his shell as having three keels on a whorl, there are in fact four, and they alternate, larger and smaller, as stated by Hinds. No mention is made by either author of the spotted carina below the periphery of the body-whorl. *Triforis* is a genus which wants monographing by a competent person, and ought to be illustrated with much enlarged photographed figures. At present it is practically impossible to identify most of the described species by means of the published figures and descriptions.

208. **Triforis sculptus,** Hinds, **20,** *a*. XIV.

This species varies much in size, and is sometimes considerably larger than the shell figured by Hinds or the dimensions given in his original description[1]. The largest specimen in the British Museum is 20 mm. in length, whereas another, equally adult, is only 15.

209. **Triforis lilaceocinctus,** n. sp. (Pl. XXXV. fig. 15). XIV.

Testa elongato-pupoidea, supra acuminata, granulis flavescentibus et albis, lirata, inter granula rufo punctata; anfractus circiter 15, superiores liris duabus granosis aequalibus instructi, pauci anteriores lira graciliore mediana, dilute lilacea, vix granulata ornata, sutura lineari sejuncti, microscopice spiraliter striati, ultimus circa basim lilaceus, liris aliis tribus nodulosis, rufo punctatis, instructus; apertura obliqua, piriformis; canalis parvus, dextrorsus, semiclausus.

Longit. $10\frac{1}{2}$ mm., diam. $3\frac{1}{2}$ mm.

A general glance at this pretty species gives the impression that the whorls have each two adjacent rows of large granules. Such however is not the case. It is the lower row in one whorl being adjacent to the upper one in another (the linear suture being between) that gives this appearance, the unspotted and more slender median lirae also lending to the effect. This lira gradually dies out as it ascends the spire, so that the upper whorls have only two rows of equal sized granules. This species also occurs at the Mauritius (Brit. Mus.).

210. **Triforis excellens,** n. sp. (Pl. XXXV. figs. 16, 17). V.

Testa magna, dilute fuscescens, hic illic saturatius maculata; anfractus numerosi (25—30), plani, cingulis tribus aequalibus acutis cincti, inter cingula laeves, ultimus ad peripheriam bicingulatus, infra vix convexus, liris 4—5 instructus; apertura irregulariter quadrata; labrum tenue; columella callo reflexo crassiusculo induta.

Longit. 29 mm., diam. 6 mm.

The spirals are equal in size, but the space separating the lowermost from the median one is a little broader than the groove between the upper two. The suture except at the upper part of the spire is marked with a spiral thread.

[1] *Ann. Mag. Nat. Hist.* 1843, vol. xi. p. 17.

211. **Triforis gracilior,** n. sp. (Pl. XXXV. figs. 18, 19). V.

Testa *T. excellenti* similis, sed gracilior, cingulis duobus inferioribus subundulatis, alba, hic illic fusco maculata.

Longit. 28 mm., diam. 5½ mm.

Like *T. excellens*, this species has three keels upon each whorl, but they are not so equal, the uppermost being a trifle more slender than the others. The latter also are slightly affected by faint longitudinal depressions giving them an obscurely beaded appearance. The body-whorl is bicarinate at the periphery and has three or four lirae beneath. As in the preceding species, the space between the second and third keel is a little broader than that which separates the first and second, and the suture is filo-lirate.

212. **Triforis pura,** n. sp. (Pl. XXXV. figs. 20, 21). XII.

Testa elongata, alba, clathrata, granulata; anfractus circiter 20, fere plani, costis spiralibus tribus granosis inaequalibus (costa mediana minima) cincti, inter costas longitudinaliter costati, ultimus costis senis (prope labrum duabus intercalatis) ornatus; canalis dextrorsus, clausus, laevis; apertura irregulariter ovata, obliqua; labrum antice prominens, postice recedens; columella callo crassiusculo reflexo induta.

Longit. 14 mm., diam. 3.

Of the three spirals the uppermost is a little stouter than the lowermost and the central one is rather finer than the latter. The granules form oblique rows of three, being connected by the longitudinal costae. The suture is thread-like.

213. **Vertagus fasciatus,** Bruguière, var. **40,** *a, XV.* VIII, IX.

214. **Vertagus kochi,** Philippi, **40,** *a, XV.* XI.

215. **Vertagus articulatus,** A. Adams and Reeve (*Cerithium articulatum*, Adams and Reeve, **3.** *V. articulatus*, Sowerby, **40,** *a, XV.*) VI, X.

216. **Vertagus obeliscus,** Bruguière, var. *cedo-nulli* (*V. cedo-nulli*, Sowerby, **40,** *a, XV.*) I, IX.

V. cedo-nulli is perhaps separable from *obeliscus*.

217. **Cerithium columna,** Sowerby, **40,** *a, XV.* IX, XI, XIII.

218. **Cerithium echinatum,** Lamarck, **40,** *a, XV.* XIII.

219. **Cerithium lacteum,** Kiener, **40,** *a, XV.* XI.

220. **Cerithium piperitum,** Sowerby, **40,** *a, XV.* IX.

221. **Cerithium salebrosum,** Sowerby, **40,** *a, XV.* II.

222. **Cerithium tuberculatum,** Linn. (var.=*C. variegatum*, Quoy and Gaimard, **40,** *a, XV.*) XI.

223. **Cerithium albovaricosum,** Smith, var. **39,** *g.* I.

Three specimens, a little larger (19 mm. long), paler, and with less of the brown dotting between the costae than in the type.

224. **Terebralia palustris,** Linn. (*Pyrazus palustris*, Sowerby, **40,** *a, XV.*) XI.

225. **Modulus tectum,** Gmelin, **41,** *IX.* IX.

Family PLANAXIDAE.

226. **Planaxis ineptus,** Gould, **17, 40,** *a, XX,* **41,** *IX.* X.

The Maldive specimens are a little larger than the dimensions given by Gould, being $5\frac{1}{2}$ mm. in length. Most of them also exhibit a purplish stain on the columella which is not referred to in the original description. There are generally three principal colour lines upon the body-whorl —one above the periphery, one below it and the third still more anterior.

Family LITTORINIDAE.

227. **Littorina glabrata,** Philippi, **33,** *b,* **37,** *X.* XI, XV.

228. **Littorina scabra,** Linn. **37,** *X.* XV.

229. **Littorina undulata,** Gray, **37,** *X.* XI, XV.

Family SOLARIIDAE.

230. **Solarium modestum,** Philippi, **40,** *b, I.* V.

231. **Philippia cingulum,** Kiener, **40,** *b, III.* II, IX.

Family HIPPONYCIDAE.

232. **Mitrularia cicatricosa,** Reeve (*Calyptraea cicatricosa,* Reeve, **37,** *XI.*) IX.

233. **Mitrularia equestris,** Linn. (*Calyptraea equestris,* Reeve, **37,** *XI.*) IX.

234. **Hipponyx danieli,** Crosse (*Capulus danieli,* Crosse, **11,** *b*). III—V.

235. **Hipponyx australis,** Lamarck, **41,** *VIII.*

Family CAPULIDAE.

236. **Thyca crystallina,** Gould (*Hipponyx crystallinus,* Tryon, **41,** *VIII.*) VIII.

Family XENOPHORIDAE.

237. **Xenophora indica,** Gmelin, **41,** *VIII.* (*Phorus indica,* Reeve, **37,** *I.*) V.

Family VANICOROIDAE.

238. **Vanicoro cancellata,** Lamarck, **41,** *VIII.*, **40,** *b, V.* IX, XIII.

Family NATICIDAE.

239. **Natica robillardi,** Sowerby, **40,** *d.* XII, XV.

240. **Natica euzona,** Recluz (Pl. XXXV. fig. 22), **36** (*N. picta,* partim, Reeve, **37,** *IX. N. decora,* Philippi, **33,** *a*). VII.

The operculum of this species is shelly, white, concave externally, shining except in the middle where there is a dull opaque thickening. The outer curved side has a thickened edge, within

which is a parallel furrow and then a raised ridge or rounded keel. The convex side is covered with a thin yellow pellicle and is marked with lines of growth.

241. **Polinices mamilla,** Lamarck (*Natica mamilla*, Reeve, **37,** *IX.*) III, IX, XII, XV.

242. **Polinices albumen,** Lamarck (*Natica albumen*, Reeve, **37,** *IX.*) III.

243. **Mamilla melanostoma,** Lamarck (*Natica melanostoma*, Reeve, **37,** *IX.*) VI, XV.

244. **Mamilla simiae,** Deshayes (*Natica simiae*, Reeve, **37,** *IX.*) IX.

Family IANTHINIDAE.

245. **Ianthina communis,** Lamarck? **37,** *XI.* IX.

The figures most resembling the specimens from the above station are Reeve's figures of *I. affinis* (figs. 2 *a*, *b*). That so-called species and several others described in the same monograph are probably mere varieties of one variable species. (See Tryon, *Man. Conch.* vol. IX. pp. 36, 37.)

Family SCALIDAE.

246. **Scala replicata,** Sowerby (*Scalaria replicata*, Sowerby, **40,** *b, I.*) IX.

247. **Scala consors,** Crosse and Fischer (*Scalaria consors*, Tryon, **41,** *IX.*) XI.

A single example considerably larger than the type, being 18 mm. long, and 7 mm. in width. The locality given by Crosse and Fischer is St Vincent's Gulf, S. Australia, but four specimens, supposed to include the type among them, were presented to the British Museum in 1870 by Mr G. F. Angas and were marked "Ceylon" by him. The Maldive example has a dark line at the suture.

248. **Scala (Cirsotrema) texta,** n. sp. (Pl. XXXV. fig. 23). X.

Testa elongata, subulata, imperforata, solidiuscula, albida, longitudinaliter plus minus plicata, varicibus paucis obliquis instructa, spiraliter sulcata et tenuiter punctato-striata, lineis incrementi tenuissimis obliquis sculpta; anfractus circiter 12, supra valde declives, vix concavi, in medio obtuse angulati, sutura obliqua irregulariter corrugata sejuncti, ultimus ad peripheriam angulatus, costis ad angulos subnodosis; apertura oblique ovata; peristoma continuum, expansum, margine externo varice crasso circumdato. Longit. 17 mm., diam. 5; apertura intus 3 longa, 2 lata.

This very distinct species is well-characterized by the fine cancellated sculpture, like a piece of linen, the interstices being minutely punctate. The whorls exhibit spiral shallow sulci and intervening raised ridges, both the latter and the grooves being covered with the spiral and longitudinal striae. Every second or third whorl exhibits an oblique varix, and the upper ends of the plicae form a very irregular puckered or dentate sutural line.

Allied to *S. bicarinata*, Sowerby, but much larger, of different form, differently plicate and spirally sulcate.

Family PYRAMIDELLIDAE.

249. **Pyramidella corrugata,** Lamarck, **23.** XV.

250. **Pyramidella nodicincta,** A. Adams, **40,** *b, II.* XIV.

251. **Obeliscus dolabratus,** Linn. (*O. dolabratus* and *O. terebellum*, **40,** *b, II.*) IX, XV.

252. **Obeliscus monilis,** A. Adams, **40,** *b, II.* IX, XIV.

253. **Obeliscus sulcatus,** A. Adams, **40,** *b, II.* XV.

Family NERITIDAE.

254. **Nerita albicilla,** Linn. **37,** *IX.* IX, XV.

255. **Nerita histrio,** Linn. **37,** *IX.* XI.

256. **Nerita plicata,** Linn. **37,** *IX.* IX, XI.

257. **Nerita polita,** Linn. **37,** *IX.* I, XII.

Family TURBINIDAE.

258. **Turbo** (**Senectus**) **argyrostoma,** Linn. **37,** *IV.* (var. = *T. margaritaceus*, Reeve, **37,** *IV.*) IX, XI, XV.

Family LIOTIIDAE.

259. **Liotia squamicostata,** n. sp. (Pl. XXXV. fig. 24). X.

Testa subglobosa, anguste umbilicata, alba; anfractus quatuor, ad suturam canaliculati, costis granosis spiralibus (in anfractu penultimo 4, in ultimo 8) cincti; granula ad peripheriam subsquamiformia; apertura circularis, margine externo crenulo, columellari incrassato, reflexo. Diam. maj. 5 mm., alt. 4.

The spiral ridges are rather strong, broader than the grooves between them, and the granules upon the second, third, fourth, and fifth upon the body-whorl, and the second and third upon the penultimate, are scale-like, and that which encircles the umbilicus is much thicker than the rest and transversely grooved. The terminations of the spirals upon the outer lip give it a crenulated aspect.

Family TROCHIDAE.

260. **Trochus** (**Lamprostoma**) **incrassatus,** Lamarck, **34,** *XI.* I, XV.

261. **Trochus** (**Lamprostoma**) **maculatus,** Linn. **34,** *XI.* IX, XI.

262. **Trochus** (**Lamprostoma**) **obesus,** Reeve, **37,** *XIII.* IX.

263. **Trochus** (**Lamprostoma**) **radiatus,** Gmelin, **34,** *XI.* XI.

264. **Thalotia maldivensis,** n. sp. (Pl. XXXV. figs. 25, 26). II, X.

Testa parva, elate conica, imperforata, ad peripheriam acute angulata, supra viridis, ad suturam albo et roseo maculata, apicem versus rubescens, supra anfractum ultimum strigis albis obliquis paucis ornata, infra roseo et albo tessellata; anfractus 8—9 plani, seriebus granulorum parvorum septenis (quarum series duae inferiores contiguae et albo et roseo maculatae) instructi, ultimus infra angulum seriebus 9—10 ornatus, subplanus; apertura obliqua, subquadrata, margaritacea, iridescens; labrum tenue; columella alba, incrassata, reflexa, leviter arcuata, antice truncata.

Diam. maj. $7\frac{1}{2}$ mm., min. 7, alt. 10. Var. Testa rufescens, concolor.

A very pretty conical shell, generally more or less green with a white and pink spotted band above the suture and dotted with pink in the middle of the base. Some examples are uniformly pinkish reddish and with only tinges of green above or below.

265. **Clanculus atropurpureus**, Gould (*Trochus* (*Clanculus*) *atropurpureus*, **34**, *XI.*) IX, XIII.

266. **Perrinia angulifera**, A. Adams (Pl. XXXV. fig. 27); (*Turcica* (*Perrinia*) *angulifera*, **34**, *XI*). X.

267. **Forskalia pulcherrima**, A. Adams (*Gibbula pulcherrima*, Pilsbry, **34**, *XI.*) IV, VI.

268. **Monilea calyculus**, Wood, **34**, *XI.* II—IV.

269. **Monilia simulans**, Smith, var. **39**, *c.* V, VI, X.

These specimens differ from the type in having only very faint indications of the nodose plications at the upper angle of the whorls. They also differ in colour, being paler and less rosy. *Trochus* (*Monilea*) *warnefordi*, G. and H. Nevill, may be the same as this species.

270. **Ethalia rhodomphala**, n. sp. (Pl. XXXVI. figs. 1, 2). III, V, X.

Testa orbiculata, supra breviter conica, semiobtecte anguste umbilicata, ad peripheriam acute angulata, supra albida, maculis paucis remotis fuscis et lineis tenuissimis irregularibus undulatis radiatim picta, ad peripheriam maculis semipellucidis roseo pictis ornata, infra lineis albis opacis irregularibus subzigzagformibus variegata, circa umbilicum rosea; anfractus sex leves, nitidi, ultimus circa medium striis paucis sculptus, circa umbilicum radiatim plicatus; apertura oblique subquadrata, margaritacea, iridescens; columella crassa, in medio margaritacea, valde reflexa, alba vel rosea, callosa, umbilicum semiobtegens.

Diam. maj. 8 mm., min. 7, alt. $3\frac{2}{3}$.

Viewed with the naked eye, the upper surface of this shell looks whitish with a few brown radiating blotches. A closer inspection with a lens, however, reveals the presence of very fine lineation, more or less broken up, undulating or dotted. The puckering around the umbilicus is pinkish, the rest of the base being covered with opaque white irregular markings upon a sub-translucent ground. The last whorl is angled at the periphery and above the angle is marked with a few distinct spiral striae.

Family STOMATELLIDAE.

271. **Gena auricula**, Lamarck, **34**, *XII.* IX, XIII.

Family HALIOTIDAE.

272. **Haliotis ovina**, Chemnitz, **34**, *XII.* IX, XII.

The number of open perforations may vary from two to six.

Family FISSURELLIDAE.

273. **Glyphis bombayana**, Sowerby, **34**, *XII.* IX.

274. **Glyphis singaporensis**, Reeve, **34**, *XII.* XIII.

275. **Emarginula incisura**, A. Adams, **34**, *XII.* XIII.

The locality of this species has not previously been recorded. The single specimen obtained is of a greenish yellow tint externally and the central portion of the interior is of a somewhat similar colour. The anterior slit is very peculiar, being clean-cut, and extending from the margin almost to the apex.

276. **Emarginula planulata**, A. Adams, **34**, *XII.* VIII.

A single specimen apparently inseparable from this species.

Family CHITONIDAE.

277. **Chiton (Sclerochiton) miles**, Carpenter, **34**, *XIV.* I.

Torres Straits is the only locality previously known for this *Chiton*.

278. **Schizochiton incisus**, Sowerby, **34**, *XIV.* I.

This I believe is the first record of the occurrence of this remarkable species in the Indian Ocean.

Family ISCHNOCHITONIDAE.

279. **Callochiton platessa**, Gould, **34**, *XIV.* V.

280. **Ischnochiton hululensis**, n. sp. (Pl. XXXVI. figs. 3—6). IX.

Testa ovata, mediocriter elata, roseo-albida, punctis roseo-griseis numerosis ornata, cingulo minute squamulato, albido viridi-griseo maculato, circumdata; valvae undique minute decussatae, antica transversim corrugata, lamina inserta brevi, fissuris novem instructa, medianae areis lateralibus bene circumscriptis, elatis, transversim corrugatis, postica mucrone centrali instructa, dimidio posteriori convexo, anteriore concavo et corrugato, lamina inserta fissuris undecim parata; squamae cinguli minutae, acute ovales, transversim striatae.

Longit. 13 mm., diam. 19.

The single specimen obtained is of a pale pinkish colour down the sides of the valves and whitish flecked and spotted with greenish grey down the middle. The hinder almost straight edge of the valves is pale with a few greenish grey spots and a dash of the same colour occurs along the sides in front of the lateral areas. The girdle is covered with alternate patches of greyish green and white scales. The insertion-plates of median valves have a single slit, that of the front valve has nine slits and that of the tail-valve eleven.

281. **Ischnochiton feliduensis**, n. sp. (Pl. XXXVI. figs. 11—14). VII.

Testa ovata, mediocriter elata, in medio carinata, pallida, sordide alba; valvae tenuissimae, antica et areae laterales valvarum centralium minute granulatae; areae centrales longitudinaliter grano-liratae; valva anterior semicircularis, postice in medio sinuata; mucro valvae posterioris ante-medianus, parum prominens; cingulum album, squamis minutis striatis ornatum. Longit. 6 mm., diam. 4 mm.

Remarkable for the thinness of the valves, the flatness of the lateral areas, and its style of sculpture. The posterior valve has twelve slits in the insertion plate, the anterior has nine and the intermediate valves one.

282. **Ischnochiton maldivensis**, n. sp. (Pl. XXXVI. figs. 7—10). VII.

Testa elongato-ovata, elata, convexa, in medio subcarinata, pallida, plus minus rufescens, albo minute punctata, cingulo minute squamulato griseo maculato circumdata; valva antica et areae laterales laeves, areae centrales sulcis paucis longitudinalibus utrinque sculptis, valva posterior in medio mucronata; squamae cinguli minutae, adamantiformes, indistincte striatae.

Longit. 8 mm., diam. 4.

The salient features of this species are the smoothness of the head-valve and the lateral areas, and the distinct incised lines upon the sides of the central areas, a space down the middle of

the shell being smooth. The insertion plates are thick and striated across the edge. The anterior valve exhibits eight slits, the posterior ten and the median valves none.

Family ACANTHOCHITIDAE.

283. **Acanthochites (Loboplax) laqueatus**, Sowerby, **34**, *XIV.* (*Angasia tetrica*, **34**, *XIV.*) V, XII, XIV.

Testa parva, elongata, subdepressa, purpureo-rosea, albo variegata, valvis antica et postica pallidis, cingulo puniceo vel viridi, hic illic albo maculato, circumdata; valvae rugose squamatae; antica costis radiantibus quinque vix elatis instructa, undique squamata, medianae angustae, in medio postice rostratae, area dorsali sublaevi, postica undique squamata, breviter mucronata.

Longit. 16 mm., diam. 12 mm.

This species is remarkable for its brilliant variable colour, the narrowness of the central valves and their coarse squamulation.

The anterior valve in the Maldive specimens is greenish grey with five paler rays and the posterior margins are also whitish with one or two black spots. Central valves purplish rose with some whitish streaks or wrinkles on each side the dorsal area. Mantle purple red with a white spot on each side the first, seventh and eighth valves surrounding the lateral pores there situated, also some black spots set in white rings all round the edge, about 17 or 18 altogether, and with a fringe at the extreme margin of short white spicules.

Another specimen has the valves similarly coloured, only the seventh is decidedly green excepting the rosy-purplish dorsal area. The mantle, however, is of a vivid green, with a white stripe on each side the anterior valve and four or five stripes or spots in front, the outer margin with a similar fringe of spicules.

Valves. First valve semicircular, the posterior margins being slightly divergent, exhibiting five not much raised rays which, like the rest of the surface, are covered with coarse elongate scales which are finer towards the middle of the hinder edge. Insertion plate finely striated externally, acute at the edge, with five shallow slits.

Central valves narrow, curved in front and rather acutely beaked behind; dorsal area narrow, smooth, with cross marks of growth; squamae arranged in rows, some parallel with the posterior margin, others obliquely across the valves, three or four rows on each side the dorsal area being white; insertion plates with a single posterior slit.

Posterior valve semicircular, shortly mucronate, squamate everywhere, except upon the short mucro which of course is like the dorsal area of the preceding valve; insertion plate thickish, with nine slits.

The colour of the interior of the valves of the only specimens disarticulated is a pinkish flesh tint, the head and tail valves being paler than the rest.

It does not seem to me advisable to place this species in the genus *Angasia* as distinct from *Acanthochites*. I might also point out that the name *Angasia* was preoccupied in Crustacea. (See *P. Z. S.* 1863.)

Family CRYPTOPLACIDAE.

284. **Cryptoplax burrowi**, Smith, **34**, *XV.* IX.

Family NEOMENIIDAE.

285. **Proneomenia australis**, Thiele, **34**, *XVII.* V.

Only a single specimen, apparently belonging to this species, was obtained.

Family SPONDYLIDAE.

286. **Spondylus imperialis**, Chenu, **37**, *IX.* IV.

Family LIMIDAE.

287. **Lima (Mantellum) fragilis**, Chemnitz, **40**, *b*, *I.* I, IX, XI, XV.

288. **Lima (Mantellum) inflata**, Chemnitz, **40**, *b*, *I.* (*Lima fasciata*, **40**, *b*, *I.*) XIII.

289. **Lima squamosa**, Lamarck, **40**, *b*, *I.* II.

290. **Lima (Ptenoides) tenera**, Chemnitz jun.? **40**, *b*, *I.* V.

Family PECTINIDAE.

291. **Pecten senatorius**, Gmelin, **40**, *b*, *I.*, **37**, *VIII.* II—VI.

Only young specimens obtained. *P. layardi*, Reeve, *P. cristularis*, Adams and Reeve, *P. rugosus*, Sowerby and some other so-called species, I regard as half-grown or young specimens of the present form.

292. **Pecten lemniscatus**, Reeve, var. **37**, *VIII.* II.

293. **Pecten mirificus**, Reeve, **37**, *VIII.* V.

294. **Pecten noduliferus**, Sowerby, **40**, *b*, *I.* V, XII.

295. **Pecten irregularis**, Sowerby, **40** *b*, *I.*, **15.** V, X, XII.

Remarkable for the very numerous fine costae which are closely prickly scaled in fresh young specimens.

296. **Pecten nux**, Reeve, **37**, *VIII.* II, V, VI.

297. **Pecten cooperi**, n. sp. (Pl. XXXVI. figs. 15—18). VII.

Testa parva, compressa, albida, rufo maculata, aequivalvis; valva sinistra costis principalibus novem et aliis gracilioribus intercalatis instructa, supra costas pulcherrime concentrice lamellata; auriculae valde inaequales, postica minima, antica costis 2—3 magnis aliisque paucis tenuibus ornata, transversim tenuiter lamellata, lamellis supra costas incrassatis, conspicuis; valva dextra costis circiter 12, tri- vel quadripartitis, instructa, concentrice tenuiter lamellata; auricula antica costis tenuibus radiantibus circiter 10 squamulatis ornata, costa suprema marginali maxima.

Longit. $12\frac{1}{2}$ mm., alt. $14\frac{1}{2}$, diam. 4.

A single example only was obtained. The species has very remarkable sculpture and very unequal auricles. The concentric lamellae are similar on both valves but the costae are different. On the left valve there are about nine principal ones with a secondary one between them and often with still finer ones on each side of the secondaries. The right valve has about twelve costae each made up of three to five small ones, or in other words it is ornamented with numerous

slender riblets arranged in groups of three to five. Named after Mr Forster Cooper who was associated with Mr Stanley Gardiner in the exploration of these islands.

298. **Pecten maldivensis**, n. sp. (Pl. XXXVI. figs. 19, 20). II, IV, VI.

Testa compressissima, albida, plus minus roseo radiata et maculata, et maculis albis opacis interdum variegata, tenuissime radiatim striata, lineisque incrementi tenuibus sculpta; valvae subaequales, dextra vix convexiore; auriculae inaequales, posticis paulo majoribus, levibus, anticis costis tenuissimis paucis radiantibus ornatis.

Longit. 17 mm., alt. 19, diam. $3\frac{1}{2}$.

Very compressed and usually very finely radiately striated, but sometimes smoother, with less distinct striae. The colour is variable, some specimens are entirely white with only a few colour-spots on the dorsal slopes. Others are dirty whitish, with about seven rather obscure reddish rays and one example has the right valve rayed with red and the left blotched with opaque white and red. All exhibit the red-spotting at the sides of the dorsal slopes.

299. **Janira gardineri**, n. sp. (Pl. XXXVI. figs. 21, 22). V, VII.

Testa mediocriter compressa, suborbicularis, costis 19 planatis, quadratis, latioribus quam sulci, instructa, undique confertim tenuissime concentrice lamellata; valva sinistra plana, albida, rufo lineata et punctata, dextra alba, umbones versus rufo tincta; umbones laeves, acuti, contigui, haud radiatim striati, nitidi, albidi, lateribus convergentibus rectis; auriculae inaequales, posticis paulo majoribus, costis paucis radiantibus tenuibus parum conspicuis instructae, transversim tenuissime lamellatae, et linea cardinis valvae dextra squamicristata; pagina interna alba.

Longit. 25 mm., alt. 23, diam. 6.

A very beautiful species well characterized by the flat-topped and square-cut costae which are rather broader than the intervening grooves. The concentric fine lamellae seem liable to disappear from the grooves in the flat valve, but they are very conspicuous on the costae and towards the umbo are thickened, so that they are more like granules than lamellae. The red markings occur both on and between the ribs. In the convex valve the lamellae are as conspicuous in the sulci as upon the costae. The lamellae upon the auricles are much more delicate and closer than those upon the rest of the shell. This species probably attains larger dimensions than those given above.

300. **Pallium plica**, Linn. (*Pecten plica*: Reeve, **37**, *VIII*). II—VI.

301. **Amussium paucilirata**, n. sp. (Pl. XXXVI. figs. 23, 24). V.

Testa parva, compressa, tenuis, pellucida, laevis, polita, aequivalvis, valva sinistra alba, dextra pellucida albo et rufo radiata et variegata, radio conspicuo albo supra latus anticum ornata; auriculae inaequales, postica valvae sinistrae infra leviter sinuata, posteriori valvae dextrae majori; umbones acuti; pagina interna radiatim substriata, lira brevi unica utrinque instructa.

Longit. $7\frac{1}{2}$ mm., alt. $7\frac{1}{2}$, diam. 2.

An interesting little species, having one valve pure white and the other mottled and rayed with white and red. The presence of only two internal lirae is also remarkable. In addition to these a short lira runs from the ligament-pit along the base of each auricle. Although the surface of both valves looks smooth and glossy, under a lens fine striae of growth are visible. The umbones are acute, that in the coloured or right valve being a little more prominent than that of the left. The opaque white ray down the anterior side appears to be a specific feature, for it is present in all the specimens examined.

302. **Semipecten forbesianus**, Adams and Reeve, **37**, *VI*.

Family PTERIIDAE.

303. **Malleus anatinus**, Gmelin, **37**, *XI.* IV.

304. **Vulsella rugosa**, Lamarck, **13.** XII.

305. **Electroma ala-corvi**, Chemnitz (*Avicula ala-corvi*, Reeve, **37**, *X.*) XV.

306. **Electroma zebra**, Reeve (*Avicula zebra*, Reeve, **37**, *X.*) X.

307. **Melina perna**, Linn. (*Ostrea perna*, Hanley, **19**, *b.* *Perna* (*Isognomon*) *samoensis*, Baird, **5.**) XI.

308. **Pinna muricata** (Linn.), Reeve, **37**, *XI.* XV.

309. **Pinna nigra** (Chemnitz), Dillwyn, **37**, *XI.* IX.

310. **Pinna saccata**, Linn. **37**, *XI.* I.

311. **Pinna serrata**, Solander (jun.?), **37**, *XI.* VII.

Family MYTILIDAE.

312. **Modiola arborescens**, Chemnitz, **37**, *X.* IX, X, XIII, XIV.

313. **Modiola auriculata**, Krauss, **25, 10.** IX.

314. **Modiola flavida**, Dunker, **37**, *X.* X.

315. **Lithodomus cinnamominus**, Chemnitz, **37**, *X.* II.

316. **Lithodomus gracilis**, Philippi, **37**, *X.* XII.

317. **Lithodomus malaccanus**, Reeve (Young?), **37**, *X.* IX.

318. **Lithodomus nasutus**, Philippi var.? **37**, *X.* XIV.

319. **Lithodomus teres**, Philippi? **37**, *X.* VII, XV.

320. **Modiolaria argentea**, Reeve (*Lithodomus argenteus*, Reeve, **37**, *X.*) II.

321. **Septifer bilocularis**, Linn. (*Mytilus nicobaricus*, Reeve, **37**, *X.*) XII.

Family ARCIDAE.

322. **Arca maculata**, Sowerby, **37**, *II.* I, IX, XI, XV.

323. **Arca imbricata**, Bruguière, **37**, *II.* IX, XV.

324. **Arca (Anadara) clathrata**, Reeve, **37**, *II.* VII.

325. **Arca (Anadara) urypygmelana**, Bory, **37**, *II.* VII, IX.

326. **Arca (Anadara) antiquata**, Linn. **37**, *II.* Maldives.

327. **Arca (Scapharca) rhombea**, Born, **37**, *II.* IX.

328. **Arca (Acar) symmetrica**, Reeve, **37**, *II.* VII, VIII.

329. **Arca (Acar) domingensis**, Lamarck, **24.** II, VII, IX, XIII, XIV.

330. **Arca (Barbatia) lacerata**, Linn. **37**, *II.* II.

331. **Arca (Barbatia) lima**, Reeve, **37**, *II.* II, V, IX, XIV, XV.

332. **Arca (Barbatia) tenella**, Reeve, **37**, *II.* I, IX, XV.

Family CARDITIDAE.

333. **Mytilicardia variegata**, Bruguière (*Cardita variegata*, Reeve, **37**, *I.*) I, IX, XI, XV.

Family GALEOMMIDAE.

334. **Galeomma formosa**, Deshayes, **40**, *b*, *III.* XIV.

335. **Thyreopsis coralliophila**, H. Adams, **2.** II.

In this remarkable genus the mantle is united ventrally, with a small anterior slit for the passage of a small pointed foot, and a very minute anal opening behind, near to which the surface is somewhat scabrous or minutely papillose. There is a narrow free fold of the mantle bordering the margin of the valves which are thickened within and gives rise to a delicate riblet which extends across the inner surface of each valve from a point near the middle about half way towards the umbo[1]. Only faint traces of adductor scars are visible and probably the free edge of the mantle above referred to is the principal means of attachment to the shell. It does not appear as if it would be reflected upon the exterior of the shell when living. In a form where the valves are permanently more or less spread out almost horizontally, the animal being too large for them to close, adductor muscles would be of little service, and therefore we might expect to find them but feebly developed. The shell is of a purplish tint within and without, except towards one end, which is white. The exterior is excessively finely concentrically striate and microscopically radiately striate and the inner surface of the valves appears to be minutely pitted. The dorsal margins are thickened within and the ligament is attached in a depression of this thickening immediately beneath the minute, glossy, convex, boss-like umbones.

Family TRIDACNIDAE.

336. **Tridacna cumingii**, Reeve, **37**, *XIV.* IX.

Family CARDIIDAE.

337. **Cardium leucostoma**, Born, **37**, *II.* IX.

338. **Cardium nebulosum**, Reeve, **37**, *II.* II.

339. **Cardium maculosum**, Wood, **37**, *II.* III.

340. **Cardium levisulcatum**, n. sp. (Pl. XXXVI. figs. 25, 26). IX.

Testa irregulariter quadrata, inaequilateralis, alba, mediocriter convexa, latere antico brevi, rotundato, postico oblique curvatim truncato, multo majori, margine ventrali late arcuato; valvae radiatim anguste sulcatae quam costis multo angustiores; costae planiusculae, circiter 25, quarum

[1] This riblet is only feebly indicated in Adams's type in the British Museum by a slight sinuation of the margin at that point.

anteriores squamis transversis subgranuliformibus subconfertis instructae, posteriores haud granulatae sed transversim tenuissime striatae.

Longit. 15 mm., alt. 12, diam. 8½.

Remarkable for its somewhat compressed and quadrate form, the slender radiating sulci and the slightly raised ribs, of which only the anterior half bear transverse granules, those on the hinder half of the shell being only very finely transversely striated. The colour is entirely white excepting the dorsal margin just in front of the umbones, which is stained with pink.

341. **Cardium sueziense**, Issel, **21**, **39**, *a*. II, X, XV.

342. **Cardium** (**Laevicardium**) **lobulatum**, Deshayes, **12**, *c*. II, III, V, VII.

343. **Cardium** (**Laevicardium**) **australe**, Sowerby, **37**, *II*. IX, XII, XIII, XV.

344. **Cardium** (**Laevicardium**) **biradiatum**, Bruguière, **37**, *II*. V, VII, IX, XII.

345. **Cardium** (**Ctenocardia**) **victor**, Angas, **4**. VIII.

The ribs on the greater part of this beautiful shell are alternately larger and smaller, the former being spinosely squamate and the latter only very delicately scaled. On the posterior end the costae are about equal in stoutness and ornamented with short scale-like spines.

346. **Cardium** (**Ctenocardia**) **fornicatum**, Sowerby, **37**, *II*. V, X.

Family CHAMIDAE.

347. **Chama jukesi**, Reeve, **37**, *IV*. I.

348. **Chama imbricata**, Broderip, **37**, *IV*. IX.

Family CYPRINIDAE.

349. **Meiocardia lamarckii**, Reeve, **37**, *II*. V.

350. **Trapezium oblongum**, Linn. **37**, *I*. V.

Family VENERIDAE.

351. **Venus reticulata**, Linn. **37**, *XIV*. I, IX.

352. **Venus marica**, Linn. **37**, *XIV*. IX, XV.

353. **Venus recognita**, Smith, **39**, *a*. II.

354. **Venus toreuma**, Gould, **37**, *XIII*. IX.

355. **Circe scripta**, Linn. **37**, *XIV*. VI.

356. **Lioconcha picta**, Lamarck (*Circe picta*, Reeve, **37**, *XIV*, **38**.) III—V, VII, IX, X, XII, XV.

357. **Lioconcha sulcatina**, Lamarck, **38**. VIII, var. IX.

The variety differs from the type in being smooth anteriorly, without the fine yet conspicuous concentric striae which usually occur at that end of the shell. In form and colour-pattern they exhibit scarcely any difference. One example however is entirely white.

Family PETRICOLIDAE.

358. **Petricola lapicida**, Chemnitz, **40**, *a*, *XIX*. II, VIII, XV.

Family PSAMMOBIIDAE.

359. **Psammobia rugulosa**, Adams and Reeve, **37**, *X*. X.

360. **Psammobia pulcherrima**, Deshayes, **37**, *X*, **39**, *a*. X.

The Maldive specimen is considerably larger than the type described by Deshayes, being 31 millim. long, and 16 broad. It is whitish with several irregular somewhat broken purple red rays which are also visible upon the inner surface of the valves. The scales upon the posterior costae become obsolete as the shell increases.

361. **Asaphis deflorata**, Linn. (*Capsa deflorata*, Reeve, **37**, *X*). IX.

Family ROCELLARIIDAE.

362. **Rocellaria gigantea**, Deshayes (*Gastrochaena gigantea*, Sowerby, **190**, *a*, *XX*). IX.

363. **Rocellaria mytiloides**, Lamarck (*Gastrochaena mytiloides*, Sowerby, **37**, *XX*). XII.

Family MESODESMATIDAE.

364. **Paphia trigona**, Deshayes (*Mesodesma trigona*, Reeve, **37**, *VIII*). IX.

365. **Paphia glabrata**, Gmelin (*Mesodesma glabrata*, Reeve, **37**, *VIII*). IX.

Family LUCINIDAE.

366. **Lucina (Codakia) divergens**, Philippi, **33**, *b*. (*Lucina fibula*, Reeve, **37**, *VI*). IX.

367. **Lucina (Codakia) punctata**, Linn. **37**, *VI*. IX.

368. **Lucina (Divaricella) dalliana**, Vanatta var. **42**. IX.

Three valves from the Maldives are a trifle more globose than S. African specimens, the divaricating lines are rather less numerous, and the smooth band, where they meet, is not quite so evident. In typical and especially in young examples the posterior straight dorsal margin forms a rounded angle where it meets the posterior curved outline. This angle is less apparent in the Hulule specimens.

The very fine crenulation within the margin of the valves is similar in both forms.

This species has been erroneously quoted by Mr Sowerby as *L. quadrisulcata*, d'Orbigny, (*Marine Shells S. Africa*, Appendix, p. 26). Of this I speak with certainty as the shells so-named by him are now in the British Museum.

369. **Cryptodon globosus**, Forskäl (*Lucina globosa*, Pfeiffer, **32**). IX.

Family TELLINIDAE.

370. **Tellina elegans**, Gray, **40**, *a*, *XVII*. IX.

371. **Tellina crucigera**, Lamarck, var. *amoena*, Deshayes, **37**, *XVII*. IX.

372. **Tellina rastellum**, Hanley, **19.** XV.

373. **Tellina dispar**, Conrad, **40**, *b*, *I.* IX.

Two specimens, one white suffused with pale yellow, the other exhibiting a broad rosy ray posteriorly and a fainter one in front.

374. **Tellina rhomboides**, Quoy and Gaimard, **19**, *a.* XV.

375. **Tellina robusta**, Hanley, **19**, *a.* X, XIV, XV.

376. **Tellina rugosa**, Born, **40**, *a*, *XVII.* IX.

377. **Tellina scobinata**, Linn. **40**, *a*, *XVII.* IX.

378. **Tellina carnicolor**, Hanley, **40**, *b*, *I* (*Tellina corbis*, Sowerby, **40**, *b*, *I.* *Tellina strangei*, Deshayes, **12**, *c.*) III, X.

The types of *T. corbis* and *T. strangei* being in the British Museum collection I have carefully compared them with Hanley's species and I fail to discern even varietal differences. The "more equilateral" form in *T. corbis* spoken of by Sowerby is so very slight as to be scarcely appreciable and may be regarded merely as an individual variation. *Tellina tessellata*, Deshayes from Moreton Bay (= *T. tenuistriata*, Sowerby, *Con. Icon.* fig. 128) is also closely allied but is somewhat differently sculptured. *T. tenuistriata* is described as "orange" in colour, but the figure is purplish brown in the copy of the work at hand. In reality it is of a pale fleshy tint and orange along the dorsal margins, with some opaque white markings radiating from the umbones.

379. **Tellina verrucosa**, Hanley, **40**, *a*, *XVII.* IV.

Family SCROBICULARIIDAE.

380. **Semele jukesi**, A. Adams (*Amphidesma jukesii*, Reeve, **37**, *VIII*). VIII.

Family CUSPIDARIIDAE.

381. **Cuspidaria elegans**, Hinds (*Neaera elegans*, Smith, **39**, *a*; *Neaera moluccana*, Adams and Reeve, **3**). X.

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EXPLANATION OF PLATES.

PLATE XXXV.

Fig. 1. *Cryptophthalmus minikoiensis*, dorsal view.

Fig. 2. „ „ shell.

Figs. 3, 4. *Marginella picturata*, var.

Fig. 5. *Mitra* (*Costellaria*) *angustissima*, n. sp.

Fig. 6. *Nassa maldivensis*, n. sp.

Fig. 7. „ „ operculum.

Fig. 8. „ „ var.

Fig. 9. „ *mulukuensis*, n. sp.

Fig. 10. „ „ operculum.

Fig. 11. „ *subtranslucida*, n. sp.

Fig. 12. „ *disparilis*, n. sp.

Fig. 13. *Murex* (*Ocinebra*) *submissus*, n. sp.

Fig. 14. *Sistrum iostoma*, A. Adams.

Fig. 15. *Triforis lilaceocinctus*, n. sp.

Fig. 16. „ *excellens*, n. sp.

Fig. 17. „ „ sculpture magnified.

Fig. 18. „ *gracilior*, n. sp.

Fig. 19. „ „ sculpture magnified.

Fig. 20. „ *pura*, n. sp.

Fig. 21. „ „ sculpture magnified.

Fig. 22. *Natica euzona*, operculum.

Fig. 23. *Scalaria* (*Cirsotrema*) *texta*, n. sp.

Fig. 24. *Liotia squamicostata*, n. sp.

Figs. 25, 26. *Thalotia maldivensis*, n. sp.

Fig. 27. *Perrinia angulifera*, A. Adams.

PLATE XXXVI.

Figs. 1, 2. *Ethalia rhodomphala*, n. sp.

Fig. 3. *Ischnochiton hululensis*, n. sp.

Fig. 4. „ „ anterior valve.

Fig. 5. „ „ median „

Fig. 6. „ „ posterior „

Fig. 7. „ *maldivensis*, n. sp.

Fig. 8. „ „ anterior valve.

Fig. 9. „ „ median „

Fig. 10. „ „ posterior „

Fig. 11. „ *feliduensis*, n. sp.

Fig. 12. „ „ anterior valve.

Fig. 13. „ „ median „

Fig. 14. „ „ posterior „

Fig. 15. *Pecten cooperi*, n. sp. left valve.

Fig. 16. „ „ sculpture magnified.

Fig. 17. „ „ right valve.

Fig. 18. „ „ sculpture magnified.

Fig. 19. „ *maldivensis*, n. sp. left valve.

Fig. 20. „ „ right valve.

Fig. 21. *Janira gardineri*, n. sp. left valve.

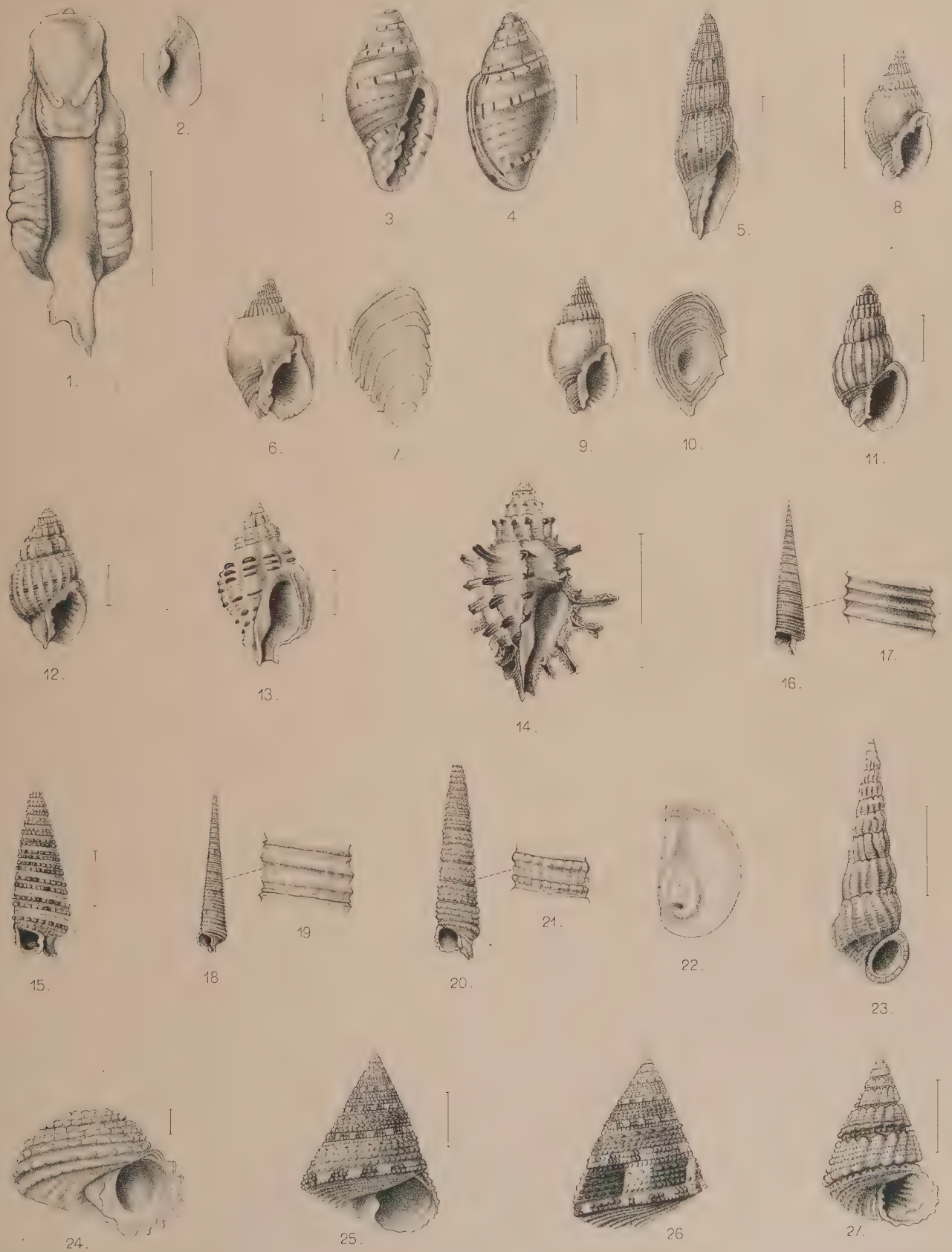
Fig. 22. „ „ right valve.

Fig. 23. *Amussium pauciliratum*, n. sp. exterior.

Fig. 24. „ „ interior.

Fig. 25. *Cardium levisulcatum*, n. sp. right valve.

Fig. 26. „ „ dorsal view.



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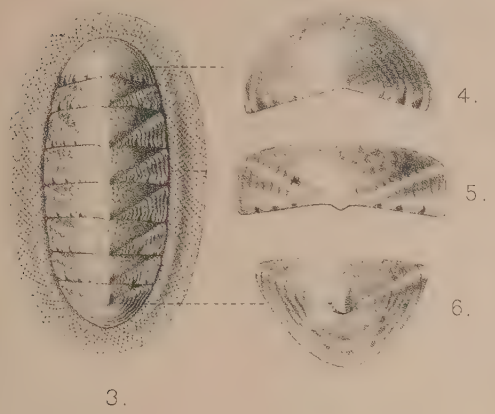

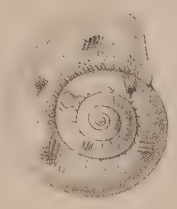

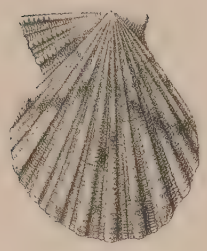

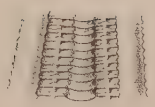

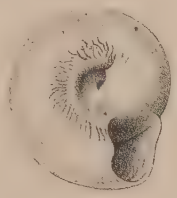

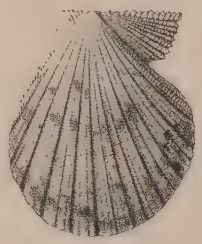

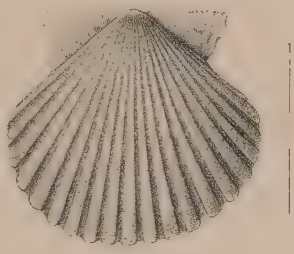

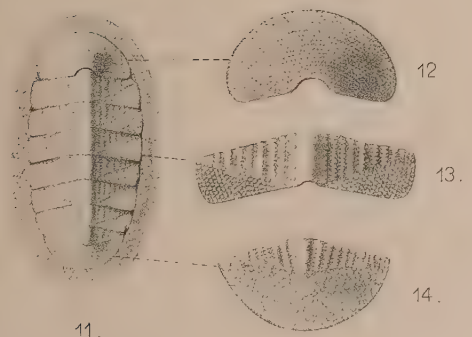

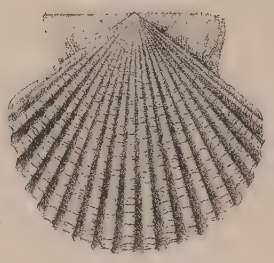

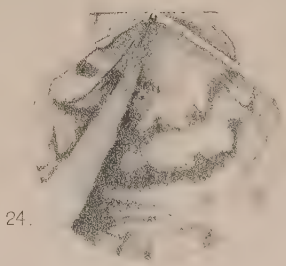

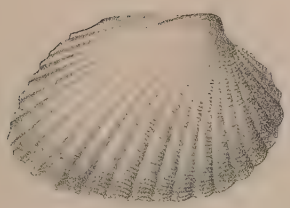

E Wilson Cambridge.

THE ENTEROPNEUSTA.

By R. C. Punnett, M.A., *Fellow of Gonville and Caius College, and Demonstrator of Comparative Anatomy in the University of Cambridge.*

(With Plates XXXVII.—XLVI. and Text-figs. 120, 121.)

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Introduction, p. 631. Systematic account, p. 631. Some anatomical points, (1) the pygochord, p. 659, (2) the lateral septa, p. 659, (3) the branchiae, p. 660. The formation of the gonads, p. 660. Variation in *Ptychodera flava*, p. 662. Metamerism in the Enteropneusta, p. 669.

INTRODUCTION.

The collection of Enteropneusta brought together by Mr Stanley Gardiner is the most extensive hitherto made in any single locality, not only in the variety of forms, but also in point of numbers. To Mr Gardiner's recognition of the importance of collecting considerable numbers and to his perseverance and zeal I owe this opportunity of making some observations on the variation shewn by the genus *Ptychodera*, a field hitherto unexplored. The material is on the whole excellently preserved, and I would here express my thanks to Mr Gardiner for entrusting to me so interesting a collection. I am also greatly indebted to Mr Forster Cooper for the coloured sketches from life which form the first plate to this paper. With the account of the Laccadive and Maldive forms I have incorporated a description of an interesting new form kindly placed in my hands by Mr Crossland, who collected it in Zanzibar. Many regenerating specimens occurred in Mr Gardiner's collection. These I hope to make the subject of a subsequent paper.

SYSTEMATIC ACCOUNT.[1]

Fam. 1. **Harrimaniidae.**

(Not represented.)

Fam. 2. **Glandicipitidae.**

PAGE

Spengelia porosa, Willey, 1898 633

Sp. maldivensis, n. sp.

Collar relatively very short with cornua of nuchal skeleton extending to extreme hind end. Dorsal septum throughout collar. Medium proboscis septum very short. Dermal pits very small. No median gonads in post-branchial region. 635

[1] The classification adopted is that recently revised by Spengel.

PAGE

Willeyia bisulcata, nov. gen., n. sp.

Collar and proboscis both very long. Branchial part of œsophagus small compared with ventral portion. No dermal pits, synapticula or median gonads . 637

Fam. 3. **Ptychoderidae.**

Balanoglossus carnosus, WILLEY, 1899 640

B. parvulus, n. sp.

Small form with very short branchial region. Genital pleurae small and widely separate at collar. Gill pouches without ventral caecum. No accessory gonads. Collar cord with continuous lumen 640

Ptychodera flava, ESCHSCHOLTZ, 1825.

Var. *parva*, nov. var.

Small form. Proboscis cavity large and with longitudinal muscles gathered into distinct separate bundles. Both proboscis pores functional. Number of dorsal roots 2—3. Branchial region short, *i.e.* less than 2 × collar length. Collar cord with continuous lumen. Nuchal cornua well developed . . . 644

Var. *laccadivensis*, nov. var.

Large form. Proboscis cavity large and with longitudinal muscles gathered into distinct separate bundles. Number of dorsal roots 3—6. Branchial region on the average more than 2 × collar length. Collar cord with continuous lumen. Nuchal cornua well developed 646

Var. *maldivensis*, nov. var.

Moderately large form. Proboscis cavity fairly large with longitudinal muscles gathered into distinct separate bundles. Dorsal roots only 1—2. Branchial region averages less than 2 × collar length. Collar cord with continuous lumen. Nuchal cornua short 648

Var. *saxicola*, nov. var.

Medium sized form. Proboscis cavity fairly large with longitudinal muscles gathered into distinct separate bundles. Dorsal roots 2—4. Branchial region very short, averaging only slightly more than collar length. Lumen of collar cord with tendency to obliteration. Nuchal cornua short 650

Var. *gracilis*, nov. var.

Small and rather slender form. Proboscis cavity fairly large with longitudinal muscles gathered into distinct separate radial bundles. Dorsal roots 2—3. Branchial region short, averaging about half as long again as collar length. Collar cord with continuous lumen. Nuchal cornua rather short 651

Var. *muscula*, nov. var.

Small, rather stoutly built form. Proboscis cavity much reduced and longitudinal muscles not gathered into distinct separate radial bundles. Branchial region fairly long, averaging more than 2 × collar length. Lumen of collar cord with marked tendency to obliteration. Nuchal cornua rather short . . . 653

PAGE

Var. *cooperi*, nov. var.

Very small form with short proboscis and collar. Proboscis cavity small and longitudinal muscles not gathered into distinct separate radial bundles. Branchial region rather more than 2 × collar length. Lumen of collar cord with tendency to obliteration. Nuchal cornua very long, overlapping branchial region 655

Pt. viridis, n. sp.

Medium sized form. Proboscis markedly longer than collar. Prevailing colour in life green. Proboscis cavity very small and longitudinal muscles not gathered into distinct separate bundles. Branchial region very short. Lumen of collar cord completely obliterated 656

Pt. asymmetrica, n. sp.

Rather small form. Proboscis cavity small and longitudinal muscles not gathered into distinct separate radial bundles. Lumen of collar cord almost obliterated. Gonads asymmetrical, on left side only 657

Spengelia porosa, WILLEY, 1898 (Pl. XXXVIII. fig. 13; Pl. XLI. figs. 5, 7; Pl. XLII. fig. 11).

LOCALITY, ETC. This species was found in three localities, viz.:

(*a*) Goifurfehendu Atoll, Goidu, where it was obtained from the sandy shore close to the east of the island in the sand below the weed and under some square slabs of beach sandstone in company with *Pt. flava*, var. *muscula*. (All this material was much macerated.)

(*b*) S. Mahlos Atoll, Mamaduwari, where it was very common under the beach sandstone masses to the north of the island.

(*c*) Male Atoll, Hulule. A single specimen was obtained from a hole in a coral mass dredged from 7 fathoms in the lagoon of Hulule Atoll. (Anterior end only.)

EXTERNAL FEATURES. In Willey's specimen the proboscis was of a rich yellow colour, the collar bright orange and the body generally of a dull yellow colour. No observations on the colour of the Maldive specimens have reached me except of the single one from Hulule. Mr Stanley Gardiner noted that the colour here was uniformly pale lemon. Much stress however cannot be laid on the difference in colour from Willey's specimen as this Hulule individual was represented only by the pre-genital part of the animal and was a rather small specimen.

The general appearance of the Maldive forms agrees closely with the figure given by Willey (**'99,** Pl. XXVII. fig. 8). The size also is about the same though the length of the proboscis as compared with the collar is on the whole slightly greater than in Willey's specimen. The relative length of the branchial region to the collar is on the average about 6, as in Willey's animal. In the single entire specimen in the collection the total length was 215 mm. The branchial region is fairly constant in its length relative to the collar in individuals of different sizes. The number of gill slits increases markedly with the size of the animal. These facts are brought out in the following table of measurements:—

	No. of Specimen.							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Length of collar	3	3	3	2·5	2·5	2·5	1·5	—
„ „ proboscis	5·5	6	5	5	4·5	4·5	4	—
„ „ branchial region ...	20	17	16	17	17·5	17	10·5	9
Total length.....	—	215	—	—	—	—	—	—
$\frac{\text{Branchial length}}{\text{Collar length}}$	6·6	5·6	5·3	6·8	7	6·8	7	—
No. of gill slits	116	—	110	104	102	88	74	58

The specimens are given in order of size, (1) being the largest, (8) the smallest.

In his account Willey states that external liver saccules are not present in the allied species *S. alba* (**'99,** p. 277), "although, when fresh, the annular ridges were found to be turgid and to present the appearance of rudimentary saccules, an appearance which was almost entirely lost after preservation." He was unable to state anything with regard to this region in *Sp. porosa* as his only well-preserved specimen lacked the post-genital portion of the body. External liver saccules are nevertheless present in *Sp. porosa*, though they are not very prominent (Pl. XXXIX. fig. 13). That they project somewhat from the dorsal surface may be more readily seen in transverse sections (see Pl. XLI. fig. 5). They are also characterized by their green colour.

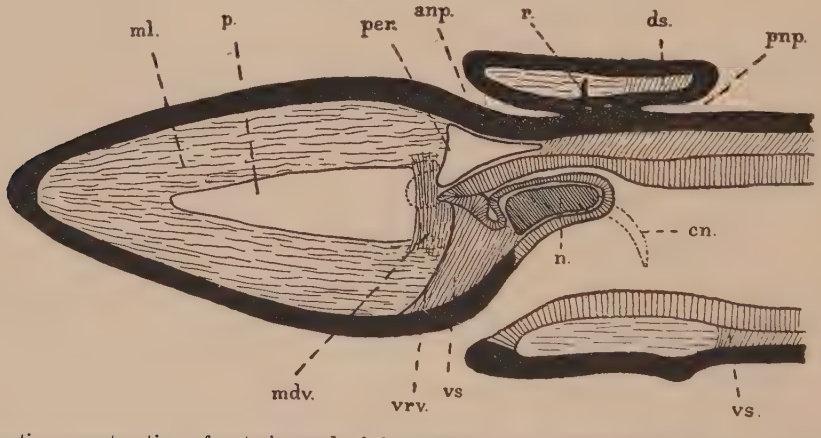

Fig. 120. Schematic reconstruction of anterior end of *Sp. porosa*, × 10. The dotted line in front of the stomochord indicates the forward extension of the pericardial auricles. For lettering see p. 676.

Internal structure. To the full and careful account given by Willey I have little to add, and that chiefly in regard to the post-genital region which, as has already been mentioned, was absent in his specimen.

Proboscis. In Willey's specimen the ventral recurrent vessel was independent of the ventral septum. In the three specimens which I have examined it runs up to the central complex in the anterior free edge of the ventral septum (Text-fig. 120, *vrv.*).

Willey states that the median muscular system extends over about $\frac{1}{3}$ of the length of the proboscis. It is not quite so long in the Maldive forms and may be exceedingly short (Text-fig. 120, *mdv.*), not extending quite so far forwards as the pericardial auricles.

The vermiform process is usually well-marked and coextensive with the dorso-ventral muscles. In the instance where these muscles were reduced the vermiform process had altogether disappeared.

Collar. Willey states that "there is no dorsal septum in the collar, except the fold of basement-membrane associated with the first vestigial root, which is probably to be regarded as a vestige of the dorsal septum. On the other hand the ventral septum has an unusual forward extension, commencing a short distance behind the region of bifurcation of the nuchal skeleton." In the Maldive forms the dorsal septum is present though only at the hind end of the collar (Text-fig. 120, *ds.*), whilst no ventral septum is to be found.

A vestigial root was found in one of the three specimens examined. It was, however, very small and did not reach to the epidermis (Text-fig. 120, *r.*). Both anterior and posterior neuropores are very deep, so that only about $\frac{1}{3}$ of the collar cord is devoid of a continuous lumen. This portion contained traces of a cavity.

In his specimen Willey found that the cornua of the nuchal skeleton extended to the extreme posterior end of the collar. This may be the condition in the Maldive specimens, whilst on the other hand the hindermost quarter of the collar may be without cornua.

The collar canals open into the first branchial pouch and I have been unable to find the truncal canals described by Willey.

Trunk. The branchial and genital regions agree closely with Willey's account.

In the hepatic region there is no internal circular musculature. The longitudinal muscles are gathered into three bands on either side, viz. a dorsal, a ventral, and a lateral one (Pl. XLI. fig. 5). Consequently there are in this region two longitudinal areas where no muscle fibres intervene between the intestinal wall and the epidermis.

In the intestinal region there is a longitudinal dorsal groove on either side which shews slight depressions at intervals (Pl. XLI. fig. 7). The circular muscles form a complete ring round the body here but the longitudinal muscles are wanting beneath the grooves. The intestine itself is small and laterally compressed, the body cavity being occupied by strands of connective tissue.

Although there are several small points of difference between the Maldivan forms and Willey's specimen I have thought it best, in view of the considerable variations shewn on these very points, not to separate these forms from Willey's. It is possible that when more material is forthcoming the differences may be found to be sufficient to separate them as distinct varieties.

Spengelia maldivensis, n. sp. (Pl. XLI. figs. 6, 8; Pl. XLII. fig. 20).

Locality, etc. Hulule. From beach sand-rock. A single specimen only was obtained and this lacked the posterior part of the body, which was broken away in the genital region.

External features. A small form and the colour after preservation is quite white. The total length of the fragment obtained was 21 mm. Of this the proboscis measured 4 mm., the collar 1·8 mm. (with a width of 3 mm.), whilst the length of the branchial region was 6 mm. Characteristic is the shortness of the collar, the length of which is not much more than half its width. The width of the genital region did not exceed 3 mm.

INTERNAL STRUCTURE.

Proboscis. The outer circular muscle layer is very delicate. The proboscis contains a central cavity which is not divided into right and left portions in front of the central complex. The long vermiform process of the stomochord runs forwards dorsal to the cavity (Pl. XLI. fig. 8, *v.*). It is somewhat fragmented in places. Where it joins the stomochord proper appears the ventral septum separating the ventral coelom into two portions, which do not subsequently join with one another. A dorsal septum also occurs in front of the junction of the pericardium with the basement membrane below the epidermis. The lumen of the stomochord is well marked in some places though obliterated in others. The lumen of the lateral diverticula is only patent at the extremity of each. The chondroid tissue is well developed. The nuchal skeleton possesses a well-marked keel.

The left proboscis pore alone is present. The right perihaemal cavity reaches forwards considerably further than that of the left side (Pl. XLI. fig. 6, *ph.*).

The pericardial auricles are very short.

Collar. The outer longitudinal muscles are poorly developed and there is no circular layer. The collar is without a cavity. The dorsal septum extends through the length of the collar, whilst the ventral one is only found complete at the posterior end.

The nerve cord is practically solid throughout, only very faint traces of a lumen being discoverable here and there. There is no sign of any dorsal root.

The cornua of the nuchal skeleton are long and reach backwards to the extreme hind end of the collar (Pl. XLI. fig. 8, *cn.*) and to some extent overlap the branchial region.

The collar pores open into the first gill pouch, which possesses a small diverticulum reaching forwards for a short distance ventral to the collar canal (Pl. XL. fig. 8, *p.*1). This is doubtless the structure referred to by Willey (**'99,** p. 280) as the truncal canal. In the present species it possesses no trace of an opening into the perihaemal space, and the diverticulum differs in nowise histologically from the rest of the gill pouch, thus lending no support to the morphological importance with which Willey is inclined to regard them.

Trunk. The circular musculature is, as usual in this genus, found inside the longitudinal layer. In the branchial region the ventral portion of the œsophagus is almost as large as the branchial division, the proportions being similar to those in *Sp. porosa* as figured by Willey (**'99,** Pl. XXXI. fig. 45). About nine synapticula are present on each gill bar. A distinct but small post-branchial groove is present (Pl. XLII. fig. 20). The grooves into which the gill pouches open are produced backwards past the branchial region. They do not however exhibit the peculiar depressions found in *Sp. porosa* and *Sp. alba* which Willey has termed dermal pits. Too much stress must not be laid on their absence, however, as the gonads are somewhat immature and it is possible that with their increase in size small dermal pits might arise. There is little doubt that they would never reach the same development as in the above-named forms, a circumstance probably correlated with the smaller size of the species under consideration.

In the branchial region both median and lateral gonads are present. In the genital region however the lateral gonads alone are present. The median gonads are always very small and are not nearly so numerous as the lateral ones.

Though the above species has been created on the strength of a single imperfect specimen yet in its short collar, its undivided proboscis cavity, the reduction or absence of

its dermal pits and median gonads, it exhibits structural differences sufficient to separate it at once from *Sp. porosa* and *Sp. alba*, the only two species of this genus hitherto described.

Willeyia bisulcata, nov. gen., n. sp. (Pl. XXXVIII. figs. 14, 23; Pl. XXXIX. fig. 29; Pl. XLI. figs. 9, 10; Pl. XLII. figs. 12—16).

Locality, etc. This species was fairly abundant at Zanzibar, whence portions of two specimens were brought back by Mr Crossland. They were obtained by digging in mud on which *Zostera* was growing at low-water mark.

External features. To judge from the fragments the length of this species must in the entire state be considerable. The proboscis is about double the length of the collar and is marked both dorsally and ventrally by a deep median groove (Pl. XXXVIII. fig. 14). Its width is somewhat greater than its dorso-ventral depth. The collar is long and is somewhat broader behind than in front. Near its posterior end there is a well-marked circular groove. In one of the two specimens available, which was somewhat larger than the other, the length of the proboscis was 14 mm., that of the collar 7 mm. The average breadth of both was about 4 mm. The branchial region and trunk have each a breadth somewhat less. In the specimen above alluded to some 32 mm. of the branchial region were still attached to the collar. No external liver saccules were visible on any of the fragments. Probably they are not present. No portion of the caudal region was preserved. With the exception of the proboscis, which is somewhat dorso-ventrally flattened, the whole body of the worm is more or less cylindrical. When living the animal was of a uniform cream colour.

Proboscis. The epithelium is high though almost destitute of glands. It shews a very distinct layer of elongated nuclei about its middle and numerous small rounded nuclei in its deeper portion. The layer of nerve fibrils is very distinct and well developed throughout this region and rests on a fine but clearly marked basement-membrane. The circular muscle layer is strong, being nearly half as thick again as the nervous layer. The longitudinal muscles are well-developed, filling the greater portion of the proboscis (Pl. XLII. fig. 12). The nervous layer is thickened in the grooves.

The proboscis coelom consists of a right and a left cavity which are entirely separate throughout. They are lined by a well-marked epithelium which is considerably thickened near the middle line (Pl. XLII. fig. 12 and Pl. XXXIX. fig. 29). The two divisions of the coelom are surrounded by a common layer of circular muscles (Pl. XLII. fig. 12). The left division of the proboscis coelom communicates with the exterior by a large pore (Pl. XLI. fig. 9). The right division ends blindly. No dorsal septum is present but there is a well-marked ventral septum, at the upper edge of which runs the ventral recurrent vessel of the proboscis (Pl. XLII. figs. 11 and 12, and Pl. XXXIX. fig. 29, *vrv.*). This septum springs from almost the tip of the proboscis and does not become complete until shortly behind where the pericardium arises. Here the ventral vessel becomes connected with the vessels of the glomerulus. On either side of the middle line are found dorso-ventral muscles, the dorsal ones being more marked than the ventral. Both converge towards the vermiform process of the stomochord where this structure is found (Pl. XXXIX. fig. 29).

The stomochord exhibits a well-marked lumen throughout, both in its central portion and in the lateral diverticula. Anteriorly it is produced forwards as a vermiform process which is about $\frac{2}{3}$ of the length of the rest of the stomochord (Pl. XLII. fig. 10).

The nuchal skeleton is strongly developed, occupying a large portion of a transverse section in the region of the proboscis stalk (Pl. XLI. fig. 9). The keel is strongly developed but much blunted, its side to side diameter being greater than the dorso-ventral one.

The pericardium is provided with two small "auricles" reaching forward about $\frac{1}{10}$ mm. from the main structure on either side.

Collar. The epithelium of this region is high and fairly well provided with gland-cells. The posterior part of the collar on either side of the circular furrow is characterized by a more highly glandular zone. In the preserved specimens this region is somewhat paler in colour than the rest of the collar. The nerve fibre layer is distinct, whilst, as in the proboscis, the basement-membrane is thin. There is no layer of circular muscles outside the longitudinal musculature.

The collar coelom is entirely filled by longitudinal muscle fibres and connective tissue, with the exception of a small space round the opening of each of the collar funnels. The dorsal septum is complete throughout the entire length of the collar. The ventral septum is lacking only at the extreme anterior end (Pl. XLI. fig. 10).

The median nuchal skeleton is long whilst its cornua are exceedingly short (Pl. XLI. fig. 10), a feature in which this genus differs markedly from the remaining members of the family. The cornua embrace nearly $\frac{2}{3}$ of the total circumference of the œsophagus.

The collar cord exhibits a well-marked anterior and a smaller posterior neuropore. The anterior neuropore especially reaches some way down into the collar (Pl. XLI. fig. 10). Towards its hinder limit it becomes somewhat separated off from the nerve cord on the dorsal surface of the latter. It is lined with a definite epithelium somewhat glandular and richly provided with cilia. The nerve cord itself is quite solid and is almost entirely surrounded by a layer of nerve fibres (Pl. XXXVIII. fig. 23). In its hinder portion it shews a well-marked ridge projecting up towards the dorsal septum. This ridge is filled with cells containing a yellowish-brown pigment. These cells reach a little way into the nerve cord and similar cells are also to be found in the perihaemal spaces (Pl. XXXVIII. fig. 23). Pigment has previously been described by Spengel (**'93,** p. 134 and Taf. 7, figs. 2, 12, 14) in the collar cord of *Balanoglossus apertus*. Without going so far as Willey (**'99,** p. 316) in claiming that the dorsal roots are homologues of the vertebrate pineal eyes it is yet conceivable that these aggregations of pigment may serve for the perception of light rays. Besides this small dorsal ridge there occurs no representative of dorsal roots in *W. bisulcata*.

From the anterior part of the collar cord passes off on either side a well-marked nerve to the layer of nerve fibrils beneath the œsophageal epithelium. These I have termed the œsophageal nerves (Pl. XLII. fig. 16, *on.*).

With regard to the histology of the collar cord it may be stated that giant cells, such as Spengel (**'93,** p. 609) has described for several species of Enteropneusts, are absent. Certain of the ganglion cells near the dorsal surface attain a somewhat larger size, but this does not exceed 20—25 μ. Faint vestiges of the remains of cavities in the cord are visible here and there under a high power. The pigment referred to above is found along the whole length of the cord.

The perihaemal spaces are well developed and ventrally contain transverse muscle fibres. They do not come into contact with one another until just in front of the point where the cornua of the nuchal skeleton diverge. Anterior to this they are widely separated by the stomochord.

The right and left peripharyngeal spaces are separate except at the hind end of the collar, where they meet ventrally. As they reach forwards their ventral borders slope obliquely and gradually upwards until the two borders merge at a spot dorsal to the œsophagus, where the circular muscles which the spaces contain are inserted into the nuchal skeleton. Where the peripharyngeal spaces are deficient ventrally the œsophagus is still provided with a layer of circular muscles probably derived from the longitudinal musculature.

Branchial region. One of the chief characteristics of the present species as compared with the other members of its family lies in the fact that the branchial portion of the œsophagus is of considerably less extent than the remainder (Pl. XLII. fig. 13). This results in the septal and tongue bars being relatively short. The musculature is in this region well-developed. Beneath the powerful longitudinal layer is a sheath of circular fibres extending up to the lower ends of the gill pouches. Noteworthy is the position of the ventral nerve cord which projects so far inwards that it almost abuts against the circular muscles. Of the posterior branchial region it is not possible to give any account, since I have been unable to identify it among the fragments which have come to me. Synapticula are absent. The first three gill pouches are dorsally confluent, forming a chamber with a single external pore into which opens the collar pore. No trace of truncal pores is to be found resembling those described by Willey (**'99**, pp. 273, 280) for *Spengelia*. The branchial region is probably devoid of gonads, or if these occur here it is only in its most posterior portion that they are to be found. In the specimen with the greater attached length of branchial region, this was about $4\frac{1}{2}$ times the length of the collar. No gonads were present even at the extreme end of this fragment.

Schizocardium	*Glandiceps*	*Spengelia*	*Willeyia*
Pericardial auricles very large.	Pericardial auricles very small.	Pericardial auricles small.	Pericardial auricles small.
No dermal genital pits.	No dermal genital pits.	Dermal genital pits.	No dermal genital pits.
Œsophageal part of branchial sac very small.	Œsophageal part of branchial sac reduced to a broad tract.	Œsophageal part of branchial sac a deep groove.	Œsophageal part of branchial sac much larger than branchial part.
Peripharyngeal cavities.	No peripharyngeal cavities.	Peripharyngeal cavities.	Peripharyngeal cavities.
Cornua of nuchal skeleton to posterior collar region.	Cornua of nuchal skeleton to posterior collar region.	Cornua of nuchal skeleton to posterior collar region.	Cornua of nuchal skeleton not found in posterior half of collar.
No median gonads.	Median gonads present or absent.	Median gonads present or absent.	No median gonads.
Synapticula.	No synapticula.	Synapticula.	No synapticula.
External liver saccules.	No external liver saccules.	External liver saccules present or absent.	(?)
Ventral proboscis septum long and reaching vermiform process.	Ventral proboscis septum short and not to vermiform process.	Ventral proboscis septum short and not to vermiform process.	Ventral proboscis septum very long but not to vermiform process.

Genital region. The longitudinal muscles are still strongly developed (Pl. XLII. fig. 14) but the circular layer has now disappeared. The ventral nerve cord still shews the peculiar

deeply sunk position which it exhibited in the branchial region. Subgenital pits such as Willey found in *Spengelia* (**'99,** p. 274) are absent. The gonads form a single row on either side of the body. Ripe spermatozoa occurred in the specimen from which the sketch of the genital region was taken.

As belonging to the family Glandicipitidae there have already been described three genera, viz. *Schizocardium*, *Glandiceps*, and *Spengelia*. It cannot be said with any confidence that *Willeyia* bears a closer resemblance to any one of these genera than to another. Features which separate it from all these three are the shortness of the nuchal cornua, the comparatively small extent of the branchial portion of the œsophagus as compared with the digestive, and possibly also the absence of gonads in the branchial region. With respect to other features of generic importance *Willeyia* resembles now one genus and now another. To which of the above genera it bears most resemblance with respect to the more salient features of its anatomy may be gathered from the appended table, p. 639.

Balanoglossus carnosus, WILLEY, 1899 (Pl. XXXVII. fig. 3).

LOCALITY, ETC. The greater portion of a very large specimen was obtained at Minikoi, at the base of a cylindrical casting in the sand flat lagoon. Fragments of the same species were also found at Hulule in sand under a large Porites mass close to the boulder zone.

A coloured sketch was made of the Minikoi specimen by Mr Forster Cooper before preservation. This is reproduced on Pl. XXXVII. fig. 3, and shews the natural colours of the animal. A bright yellow line occurred mid-ventrally which was probably the nerve cord.

The dimensions of this large specimen were taken by Mr Gardiner while it was yet alive. I have also taken them on the preserved specimen and the results of both are as follows:—

	Living	Preserved
Length of proboscis beyond collar...	9 mm.	3 mm.
Breadth „	5 „	—
Length of collar.....	22 „	13 „
„ „ branchial region	—	60 „
„ „ genital pleurae.....	—	204 „
„ „ animal obtained	440 „	355 „

When alive and undamaged the animal probably exceeded 60 cm. in length, and possessed an average diameter of 10—12 mm. The above measurements agree fairly well with those given by Willey (**'99,** p. 248). There appears to be considerable variation in the relative length of the branchial region which may be somewhat less than double the collar length, or may be as much as four times as much. The present specimen agrees with the largest of Willey's specimens, which it rivals in size, in having a relatively long branchial region.

In addition to the above fairly complete specimen a number of jelly tubes were found at the surface in castings similar to that which marked the position of the large worm. These tubes were much distended with sand, and of a transparent straw colour with bright yellow mid-dorsal and mid-ventral lines. The edge of the free (= anal?) end was marked by brown-black pigment. Doubtless these tubes are the broken off caudal ends of this species. Like *Pt. flava* (see p. 646) it may have developed the habit of autotomy.

Balanoglossus parvulus, n. sp. (Pl. XXXVIII. figs. 15, 18, 22; Pl. XXXIX. fig. 24; Pl. XLI. figs. 1—4).

LOCALITY, ETC. Represented only by a fragment comprising the anterior end and including the proboscis, collar, branchial region, and a portion of the genital region. From Mahlos Atoll.

External features. An exceedingly small form. The proboscis is nearly 1·5 mm. in length and is somewhat longer than the collar (Pl. XXXVIII. fig. 18). The branchial region is about half as long again as the collar. Width of collar and proboscis about 1·5 mm. The width of the branchial region is not quite so great, whilst the genital region is less than 1 mm. wide. The anterior border of the collar is rather wider than the rest of this part of the animal and is somewhat crinkled. Posteriorly the collar shews a well-marked circular furrow (Pl. XXXVIII. fig. 18, *t.f.*). The genital pleurae are small and are widely separated from each other where they join the collar. The mature and swollen gonads in this specimen cause the edges of the pleurae to assume a somewhat beaded appearance.

Proboscis. The proboscidial coelom is almost entirely filled by connective tissue and muscle fibres. A delicate layer of longitudinal muscle fibres is found beneath the basement membrane, but circular fibres are absent. Traces of a dorsal septum are to be found slightly in front of the pericardial sac. The ventral septum is complete at a level shortly before that at which the glomerulus ends; it carries the ventral glomerulus vessels. The ventral proboscis coelom is packed with muscle fibres and connective tissue except at its extreme posterior end where the ventral septum is lacking (Pl. XXXVIII. fig. 22, *v.c.*). A racemose organ is not present.

A single median proboscis pore is present, placing the left division of the dorsal proboscis coelom in communication with the exterior (Pl. XXXVIII. fig. 22, *p.p.*). The right moiety of the dorsal proboscis coelom ends blindly. Throughout its whole extent the stomochord shews a well-marked lumen. The lateral diverticula of the stomochord are small (Pl. XXXVIII. fig. 22, *s.c.*). The nuchal skeleton is provided with a deep narrow keel (Pl. XLI. fig. 3, *sk.*1). The chondroid tissue in this region is exceedingly scanty.

Collar. The collar epithelium is very thick (Pl. XXXIX. fig. 24, *ep.*). The glandular zone commences at the level where the cornua of the nuchal skeleton terminate and reaches to the commencement of the collar funnels. The outer longitudinal muscle layer is well-marked, particularly in the anterior and middle regions of the collar (Pl. XXXIX. fig. 24, *el.*). The inner longitudinal layer is also strongly developed. No circular muscle fibres are present.

The collar coelom is entirely filled with muscle fibres and connective tissue except for a very small space on either side of the dorsal septum. This last-named structure is first found immediately behind the first dorsal root in the middle of the collar region. Traces of a ventral septum exist but in no place is it complete. The collar funnels are of the usual form and open into the first gill pouch.

The cornua of the nuchal skeleton extend half-way round the œsophagus. In length they are short, being only about $\frac{1}{7}$ of the total collar length.

The collar cord is tubular containing a single axial canal (Pl. XXXVIII. fig. 15) surrounding which are the ganglion cells. The layer of dorsal ganglion cells (Pl. XXXVIII. fig. 15, *gcd.*) is thin, being best marked in the region where the first and second dorsal roots are given off. Above it is a much attenuated layer of nerve fibrils. The ventral ganglion cells (*gcv.*) are much more numerous and in transverse section are seen as a V-shaped mass shewing a bifurcation at the point of the V. The layer of nerve fibrils surrounding them is well-developed. Separating the dorsal and ventral ganglion cells on either side is a layer of large oval vacuolated cells—probably gland cells from which the secretion has been ejected or dissolved out. Some deeply staining mucoid substance is to be found in the medullary canal. Here and there occur ganglion cells rather larger than the rest,

but no giant cells are present such as have been figured by Spengel for *B. apertus* (**'93,** Taf. 7, fig. 18). Except at its anterior end the collar cord is sunk in the perihaemal spaces which embrace it on either side and which may posteriorly reach nearer to the dorsal surface than the cord itself. The medullary canal communicates with the exterior by the anterior and posterior neuropores.

The first two dorsal roots are large, close together, and contain nerve fibrils but are devoid of a lumen. They spring from a common crest and reach the epidermis where their nerve fibrils fuse with the nervous layer of the skin. Behind these are two or three small incomplete roots with traces of a lumen but without nerve fibrils.

A well-marked peripharyngeal space surrounds the œsophagus (Pl. XXXIX. fig. 24, *pph.*) reaching dorsally to where the cornua of the nuchal skeleton diverge, and ventrally somewhat anterior to this point.

Branchial region. This region is characterized by the small genital pleurae which are widely separate at their junction with the collar. At the base of the pleurae open the gill pouches (Pl. XLI. fig. 1, *bp.*) which are not provided with ventral caeca. The branchial and digestive portions of the œsophagus are approximately of equal size. Gonads are not found in the anterior fourth of the branchial region. Not more than six synapticula are present on either side of the tongue bars. The post branchial canal is large and the posterior incipient gill slits open into its ventral portion (Pl. XLI. fig. 2, ✲).

Genital region. The great bulk of this region is occupied by the gonads in the much swollen pleurae (Pl. XLI. fig. 4). Accessory gonads are not present, but each gonad is roughly two-branched, one division lying on either side of the lateral septum. The genital pores are found on the edges of the pleurae at the spot where the lateral septum joins the epidermis. The single specimen was an adult female.

Affinities. The genital pleurae of *B. parvulus* are relatively smaller than in any other member of the genus and in this respect it approximates to the genus *Glossobalanus.* Of the members of its own genus it bears most resemblance to *B. apertus* (Spengel, **'93**). In both the genital pleurae are widely separate where they join the collar, and this character serves to distinguish these two species from all the other members of the genus except *B. misakiensis* (Kuwano, **'02**). Both *B. parvulus* and *B. apertus* are small forms without accessory gonads, with a tubular collar cord, and with gill pouches unprovided with a ventral caecum. The present species however differs from *B. apertus* in the following features.

B. parvulus	*B. apertus*
Branchial region but little longer than the collar.	Branchial region several times as long as collar.
Gonads open at edges of genital pleurae.	Gonads open on inner surface of genital pleurae.
No circular muscles to body-wall.	Feeble circular musculature.
Tongue bars with not more than 6 synapticula.	Tongue bars with about 10 synapticula.
Medullary tube open at either end.	Medullary tube closed at either end.
Giant ganglion cells not found in collar cord.	Giant ganglion cells present in collar cord.

In *B. parvulus* also the keel of the nuchal skeleton is more marked, whilst the ventral proboscis coelom has undergone greater reduction. An idea of the relations of these two species with the other members of the genus may be gathered from the appended table.

	Size	Relative lengths of proboscis and collar	Relative lengths of branchial region and collar (approximately)	Genital pleurae	Gill pouches	Gonads	Proboscis pores	Collar cord	Roots
parvulus	Very small	Proboscis rather longer	Branch. = 1—2 × collar	Small and not in contact at collar	Without ventral caecum	No accessory. Primary branched	Median pore. Rt. coelomic sac ends blindly	Tubular	—
apertus	Small	(?)	Branch. = at least 4 times collar length	Small and not in contact at collar	Without ventral caecum	No accessory	As *parvulus*	Tubular	5 (from fig.)
australiensis ...	Large	About equal	Branch. = 3—4 × collar	Large	Without ventral caecum	No accessory. Primary much branched	Two median and confluent or single median or left only	Solid	1—5, usually 4
aurantiacus ...	Not large	Proboscis not so long as collar	Branch. = more than 5 × collar	Large	Without ventral caecum	Accessory present	As *parvulus*	Traces of cavity	1 only
clavigerus	Large	About equal	Branch. = 2—3 × collar	Large	With ventral caecum	No accessory	As *parvulus*	Traces of cavity	2—3
gigas	Giant	Proboscis about $\frac{1}{2}$ length of collar	Branch. = 5 × collar (?)	Large	With ventral caecum	No accessory (?)	As *parvulus*	(?)	(?)
carnosus	Giant	Proboscis usually less than $\frac{1}{2}$ collar length	Branch. = 2—4 × collar	Large	With ventral caecum	No accessory (except in very old ones)	As *parvulus*	Traces of cavity	2—3
bimininiensis ...	Large	Proboscis less than $\frac{1}{2}$ length of collar	Branch. = 4 × collar	Large	With ventral caecum	Accessory present	Two pores, median, confluent. Rt. coelomic sac ends blindly	Solid	1 only
jamaicensis ...	Giant	Proboscis much less than collar length	(?)	Large	With ventral caecum	Accessory present	Two pores. Separate	Solid	1 only
misakiensis ...	Large	Proboscis nearly as long as collar	Branch. = 4 × collar	Large but not in contact at collar	Without ventral caecum	Accessory present	Nearly median pore. Rt. coelomic sac ends blindly	(?)	(?)

Ptychodera flava, var. **parva** (Pl. XXXVIII. figs. 16, 20, 21; Pl. XXXIX. fig. 26; Pl. XLIII. figs. 21—28; Pl. XLIV. figs. 30—32; Pl. XLVI. fig. 48).

Locality, etc. From Turadu, S. Mahlos Atoll. About a dozen specimens procured, all more or less of the same size. They were dredged from 20 fathoms on a bottom of coarse sand.

External features. A small, somewhat short and slender form. The proboscis is of about the same length as the collar, which measures 2·5—3 mm. long, and is of approximately the same width. Behind the branchial region the body is not more than about 2 mm. wide. The liver saccules are not large and are slightly lobulated in the larger specimens. There is no apparent differentiation in colour among them as is usual in this species. The average length of the branchial region is about 1½ times the length of the collar, it being thus comparatively short (*vide* p. 673). In the single entire specimen the total length was only 30 mm.

Internal structure.

Proboscis. A delicate layer of circular fibrils surrounds the longitudinal muscles which are gathered together into radial bundles. A few longitudinal fibres are more closely gathered round the central lumen of the proboscis and give it a definite outline (Pl. XLIII. figs. 21, 22). Dorso-ventral muscles are always found dorsal to the central complex anterior to the pericardium. The ventral proboscis septum is well-marked and reaches forwards almost or quite to the tip of the stomochord. Both dorsal divisions of the dorsal proboscis coelom are in communication with the exterior by the paired and equal proboscis pores (Pl. XLIII. fig. 26). In one case the proboscis pores opened together almost in the mid-dorsal line (Pl. XLIII. fig. 23), a condition of great rarity in this genus and recalling those obtaining in *Balanoglossus apertus* (Spengel, **'94**) and *B. jamaicensis* (Willey, **'99,** p. 293).

The racemose organ is usually well-marked but is never lobulated. The lumen of the stomochord anterior to the lateral diverticula may be fairly distinct or almost obliterated. The lumen of each lateral diverticulum is large and open at the end but the portion by which it would communicate with the central lumen is usually almost or quite obliterated.

Collar. Beneath the basement-membrane is found a fine but definite layer of longitudinal muscle fibres. In the anterior part of the collar they are rather better developed and here directly enclose a delicate layer of circular muscles. No outer circular layer is found over the greater part of the collar. The anterior free cavity of the collar coelom is very spacious (Pl. XLIII. fig. 27, *c.*) extending as usual completely round the œsophagus in this region. Inside it are found the inner longitudinal muscles of the collar and within these again the peripharyngeal spaces with their enclosed circular muscle fibres. The dorsal collar septum is as usual complete immediately behind the first root. In one case it was complete just anterior to this structure. The ventral septum may be absent or present in the extreme hind portion of the collar.

The nerve cord exhibits a complete lumen throughout, though sometimes with a faint tendency to obliteration. When this occurs the height of the cord as seen in transverse section is rather greater than usual and the gland cells are more numerous (cf. Pl. XXXVIII. figs. 20 and 21). The number of the dorsal roots is either two or three. The majority reach to the ectoderm.

The cornua of the nuchal skeleton extend over nearly a quarter of the length of the collar. Their length is apparently very fairly constant for this variety (cf. Table 1, p. 645).

TABLE 1.

Ptychodera flava, var. *parva*.

No. of specimen	(1)	(2)	(3)	(4)	(5)
Proboscis coelom	Spacious. Cavity with distinct outline	as (1)	as (1)	as (1)	as (1)
Collar coelom	Very spacious	as (1)	as (1)	as (1)	as (1)
Ventral proboscis septum	To tip of stomochord	as (1)	as (1)	as (1)	Almost to tip of stomochord
Dorso-ventral proboscis muscles	Present	as (1)	as (1)	as (1)	as (1)
Dorsal collar septum	Complete after 1st root	as (1)	as (1)	Complete just before 1st root	as (1)
Ventral collar septum	Absent	as (1)	Complete at hind end of collar	as (3)	as (1)
Racemose organ	Small and unlobulated	Well marked but unlobulated	as (2)	as (2)	as (2)
Dorsal proboscis muscle decussation	Small. No ventral circular musc. fibres	as (1)	as (1)	as (1)	as (1)
Dorsal roots	*Rrr	RRr	RR	Rr	RR
Proboscis pores	*LR	LR	LR	LR	LR (opening together)
Nerve cord	Lumen complete throughout	Lumen with faint tendency to occlusion	Lumen with very faint tendency to occlusion	as (1)	as (1)
Length of post-branchial groove / Length of branchial region	—	·19	—	·15	·16
Length of cornua × 100 / Length of collar	21·2	26·5	22·8	21·7	21·0
Circumference of branchial œs. / Circumference of œsoph. œs.	1·11	1·05	1·06	1·04	1·07
Synapticula	Not more than 8	Not more than 7	as (1)	as (1)	as (1)

* R denotes a dorsal root reaching to the epidermis, r an incomplete root which does not extend to the epidermis. Of the proboscis pores L represents the left and R the right one. When the pore is functional and places the proboscis coelom in communication with the exterior a capital letter is used. When the pore is not thus functional it is denoted by a small letter.

Trunk. The branchial region, as has already been seen, is in this variety relatively short. The post-branchial groove is moderately well developed and is about $\frac{1}{6}$ of the length of the branchial region. The genital folds in the region of the branchiae are large

(Pl. XLVI. fig. 48), springing from low down. The branchial division of the œsophagus is somewhat more capacious than the ventral division of the œsophagus. The number of synapticula on the longest gill bars is either 7 or 8.

Ptychodera flava, var. **laccadivensis** (Pl. XXXIX. fig. 25; Pl. XL. figs. 36, 38—40; Pl. XLV. fig. 43; Pl. XLVI. figs. 49, 51, 57).

Locality, etc. Minikoi; from lagoon close to edge of lagoon flat. It occurred in 4 feet of water at low spring tides and was very abundant. The following notes were made by Mr Gardiner.

"A few points about them are of interest, viz. (*a*) The tail part of the body, *i.e.* posterior $\frac{1}{3}$, is merely a bag of sand and is often broken off if the animal be held still by the head end. Under these circumstances the sand appears to be driven back by peristaltic movements of the whole body-wall more rapidly than it can escape, and as a result the posterior end simply breaks off. This I have verified by repeated observations under water and I believe that it occurs in life. (*b*) In distribution they are limited to the weed and to an area close to the edge of the flat. (*c*) Their natural position when alive is within 4 inches of the surface of the sand. The head is close to the surface whilst the body and tail are horizontal. (*d*) When thrown on to a sandy bottom the motion is very feeble or *nil* if the body be full of sand. The posterior part is at once dehisced. A wriggling motion of the branchial and genital regions ensues, accompanied by powerful contractions of the collar and extensions of the proboscis. The proboscis and collar[1] are very slowly forced into the sand and then the body follows with comparative rapidity."

External features. This variety shews a great resemblance to *Pt. flava,* var. *caledoniensis* (Willey, **'99,** p. 228) in general appearance. The largest complete specimens which reached me are about 150 mm. in length, but fragments of larger specimens point to its attaining a somewhat greater size. The proboscis is of about the same length as the collar or slightly longer. The anterior liver saccules are dark, the posterior lighter in colour. The larger liver saccules are lobulated along one edge, such lobulation being most marked in the larger specimens. The length of the branchial and post-branchial genital regions are dealt with later (p. 663) in connection with variation in the group. The colour of the animal in life was bright yellow or pale lemon, thus differing somewhat from *Pt. caledoniensis,* which is of a duller hue inclining to brownish.

Internal structure.

Proboscis. Just beneath the basement-membrane occur a few delicate circular fibres surrounding the longitudinal muscles which are gathered up into radial bundles. These bundles project into the proboscis coelom, which has no well-defined boundary (Pl. XXXIX. fig. 25). Dorso-ventral muscles are usually to be found in the region of the central complex. The ventral proboscis septum extends forwards as far as the tip of the stomochord. The decussation of muscle fibres on the dorsal side of the anterior portion of the proboscis is well-marked as a rule, and a few circular fibres may be continued from it round the inner edge of the longitudinal muscles on the ventral surface of the proboscis cavity. The proboscis coelom of both sides may be placed in communication with the exterior by the two proboscis pores. It as often happens however that the communication between the proboscis coelom

[1] In *Dolichoglossus pusillus,* whose movements form the subject of a paper by Ritter (**'02**), the proboscis appears to play a relatively more important part.

and the end vesicle opening by the proboscis pore is lacking. Sometimes this occurs on one side and sometimes on the other.

TABLE 2.

Pt. flava, var. *laccadivensis*.

No. of specimen	(1)	(2) (Regenerated)	(3)	(4)	(5)	(6)
Proboscis coelom	Fairly large	as (1)	Large	Spacious	as (1)	as (1)
Collar coelom	Spacious	Small but well defined	as (1)	as (1)	as (1)	as (1)
Ventral proboscis septum	To tip of stomochord	—	as (1)	as (1)	as (1)	as (1)
Dorso-ventral proboscis muscles	Absent	—	Traces	Present	as (4)	as (4)
Dorsal collar septum	Complete after 1st root	(Regenerating)	as (1)	as (1)	After 1st root. Incomplete in places	as (1)
Ventral collar septum	Absent	Complete at hind end of collar	as (1)	as (2)	as (1)	as (2)
Racemose organ	Large and lobulated	Small and unlobulated	Well marked and slightly lobulated	Well marked. Unlobulated	as (1)	as (4)
Dorsal proboscis muscle decussation	Strong with ventral circular muscles	Feeble. No ventral circular muscles	Distinct. A few ventral circular muscles	Distinct but no ventral circular muscles	Strong with a few ventral circular fibres	Well marked. No ventral circular muscles
Dorsal roots	*RRRRRR	Collar cord in contact with epidermis throughout	RRRr	Rrrr	RRr	RRR
Proboscis pores	*lR	LR	LR	LR	Lr	lR
Nerve cord	Lumen continuous	Middle of cord solid	Lumen continuous	Lumen continuous	Lumen with strong tendency to obliteration	Lumen continuous
Length of post-branchial groove / Length of branchial region	—	—	·20	·16	—	·24
Length of cornua × 100 / Length of collar	28·7	21·1	28·9	21·1	22·5	16·2
Circumference of branchial œs. / Circumference of œsoph. œs.	—	·48	·88	·90	—	·55
Synapticula	—	—	—	—	—	—

* See foot-note on p. 645.

The racemose organ is always well-marked and in the larger specimens is usually somewhat lobulated.

Collar. The cavity in the anterior part of the collar is usually spacious though not quite to the same extent as in *Pt. parva*. The dorsal septum is usually complete after the first root. The ventral septum may be entirely absent or, equally as often, it may be found in the hinder part of the collar. The number of proboscis roots varies from three up to as many as six. The collar nerve cord usually has a distinct and continuous lumen which may rarely shew a tendency to become obliterated. The length of the cornua of the nuchal skeleton is subject to a good deal of variation. It averages a trifle less than a quarter of the collar length.

Trunk. In the branchial region the number of synapticula varies with the size of the animal. The branchial region averages rather more than double the length of the collar (p. 665, Table 8). The post-branchial groove is well-developed, its length being about one-fifth of that of the branchial region. At its anterior level the genital folds are still of considerable size (Pl. XLVI. fig. 49). At the end of the post-branchial groove the folds have become much reduced (Pl. XLVI. fig. 51). The branchial portion of the œsophagus is somewhat smaller in section than the œsophageal portion (Pl. XLVI. fig. 57). A pygochord is present in the caudal region.

Ptychodera flava, var. **maldivensis** (Pl. XXXIX. fig. 27).

Locality, etc. From Maradu, Addu Atoll, where it was taken from sandy holes of the reef-flat. Fairly abundant. Two specimens also obtained from Hulule, on the east reef underneath the stones of the boulder zone in sand.

External features. In general shape and appearance this variety is indistinguishable from *laccadivensis* to which it is very closely allied. Moreover the coloration in life was similar, this variety, like *laccadivensis*, shewing differentiation of the hepatic caeca into an anterior dark group and a posterior larger and lighter group.

Internal structure. Exceedingly similar to that of *laccadivensis* from which variety however the present one would seem to differ on the following points. The proboscis cavity has a definite outline as in *parva* (cf. Pl. XLIII. fig. 21) and does not reach up among the radial muscle bundles as in *laccadivensis* (cf. Pl. XXXIX. fig. 25).

The racemose organ is on the whole somewhat smaller.

The dorsal roots are less numerous, a feature in which this variety resembles *cooperi*.

The cornua of the nuchal skeleton are relatively shorter than in *laccadivensis*.

The branchial portion of the œsophagus is as large or larger than the ventral portion, whilst in *laccadivensis* it is always smaller.

The branchial region is relatively shorter than in *laccadivensis*, averaging only 1·63 times the collar length as against 2·26 times in the latter variety, a difference which is the more striking when one takes into account the comparatively large number of specimens examined (see below, p. 665, Table 8).

The post-branchial groove of *maldivensis* is also somewhat shorter than that of *laccadivensis*.

In point of size the present variety is considerably smaller than *laccadivensis*, preserved specimens of which may be as much as 150 mm. in length, whilst the largest specimen of

TABLE 3.

No. of specimen	*Pt. flava*, var. *saxicola.* (1)	(2)	(3)	(4)	var. *maldivensis.* (1)	(2)
Proboscis coelom	Spacious	Not large	Fairly large	as (3)	Fairly well developed and with definite outline	as (1)
Collar coelom	Spacious	Somewhat occluded by connective tissue	Spacious	Spacious	Very spacious	as (1)
Ventral proboscis septum	Nearly to tip of stomochord	as (1)	as (1)	as (1)	Nearly to tip of stomochord	Not nearly to tip of stomochord
Dorso-ventral proboscis muscles	Present	Traces	as (2)	Absent	Present	as (1)
Dorsal collar septum	Commences just anterior to 1st root	Commences ·5 mm. behind 1st root	Complete after 1st root	as (3)	Complete after 2nd root	Complete after 1st root
Ventral collar septum	Complete in hinder part of collar	as (1)	Present in hinder part of collar but not complete	as (1)	Absent	as (1)
Racemose organ	Well marked but small and unlobulated	Well marked and lobulated	Well marked and slightly lobulated	Distinct but not lobulated	Small and unlobulated	as (1)
Dorsal proboscis muscle decussation	Distinct	Strong. Also a few ventral circular fibres	Well marked. A few ventral circular fibres	Strong but no ventral circular fibres	Feeble. No ventral circular fibres	as (1)
Dorsal roots	*RRrr	Rr	RR	RRR	Rr	R
Proboscis pores	*Lr	LR	lR	LR	Lr	lR
Nerve cord	Lumen with tendency to obliteration in middle part	Lumen with marked tendency to obliteration	Lumen continuous	Lumen with slight tendency to obliteration	Lumen continuous. Slight tendency to obliteration posteriorly	Lumen continuous
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	·43	—	·22	·25	·16	·16
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	17·1	10·1	19·4	7·0	15·0	8·4
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	·33	·5	·5	·38	1·01	1·20
Synapticula	Not more than 5	Not more than 6	Up to 9	Not more than 3	—	—
$\frac{\text{Length of branchial region}}{\text{Length of collar}}$	·95	1·25	1·16	·92	1·34	1·70

* See foot-note on p. 645.

maldivensis procured was only 80 mm. long. *Maldivensis* is also a more stunted form, its total length averaging about 18 times the collar length as against 23 times in *laccadivensis*.

All of which considerations point to the fact that we are here dealing with two distinct though closely related forms.

Ptychodera flava, var. **saxicola** (Pl. XXXVIII. fig. 17; Pl. XXXIX. figs. 28, 30, 31; Pl. XLIV. figs. 33—41).

Locality, etc. Hulule, Maldive Is. Four specimens were obtained by breaking up a dead coral mass on the sand-flat.

External features. This is a relatively short stunted form. The length of the smallest specimen when preserved was 32 mm., that of the largest 65 mm. The animal is thick in comparison with its length (Pl. XXXVIII. fig. 17). The total length relative to the collar as unity in the four specimens is 16·2, 12·8, 16·5, 16·3, giving an average of rather less than 16, which is low in comparison with such forms as *laccadivensis* (see p. 664). The genital pleurae are large but the liver saccules are small and not lobulated. Neither is there any differentiation into an anterior darker and a posterior lighter group.

Internal structure.

Proboscis. The radial arrangement of the longitudinal muscles is almost as well-marked as in *laccadivensis*. The proboscis cavity is fairly spacious. Dorso-ventral muscles in front of the pericardium may or may not be present. The ventral proboscis septum reaches nearly to the tip of the stomochord. The dorsal muscular decussation in the anterior part of the proboscis is well-marked and a few ventral fibres may pass from it round the cavity of the proboscis. Paired proboscis pores are present of which one or both may be in functional communication with the dorsal coelom. The racemose organ is well-marked but differs considerably in size among the different specimens. It may shew a certain amount of lobulation.

Collar. The cavity of the anterior part of the collar is spacious. The dorsal collar septum in two cases shewed the usual condition, *i.e.* was complete after the 1st root. In one case, however, it commenced about ·5 mm. behind the 1st root, and in another a little in front of it. The ventral collar septum is more marked than usual, being in three of the four specimens complete in the hinder part of the collar.

The nerve cord may shew a lumen continuous throughout or there may be a greater or less amount of occlusion. The number of dorsal roots varies from 2—4. In one specimen a somewhat remarkable dorsal root occurred. It was of considerably larger size than usual (Pl. XXXIX. fig. 28) and was obviously formed by two distinct portions, viz. an outgrowth from the collar cord with a cap of yellowish brown pigment, and an epidermal ingrowth at the end of which was a large mass of mucus. The two portions of the root fused more or less with one another. It is possible to regard such a structure as possessing some sensory significance, and to suggest that the mucous portion of the epidermal ingrowth may act as a crude lens in focussing rays of light on the pigmented portion of dorsal outgrowth from the collar cord.

The cornua of the nuchal skeleton vary greatly in length but are on the whole unusually short.

Trunk. One of the most conspicuous features of this variety is the small size of the branchial region. Not only is the branchial portion of the œsophagus very small compared

with the ventral portion (Pl. XLIV. fig. 38), but the length of the branchial region compared with that of the collar is exceedingly short. In none of the specimens is it more than a quarter as long again as the collar, whilst in two cases it is even shorter than the latter structure.

The post-branchial groove however is well-developed, being on the average about one-third of the length of the branchial region.

The number of synapticula is very variable. As many as nine or as few as three may be present.

The genital folds are large (Pl. XLIV. figs. 38, 39) in the branchial region and also in the region of the post-branchial groove (Pl. XLIV. fig. 41). Just behind this region they rapidly diminish in size (Pl. XLIV. fig. 40). In all four specimens the gonads are quite immature. Points of interest in connection with them are dealt with later (p. 661).

An account of the pygochord is given on p. 659.

Ptychodera flava, var. **gracilis** (Pl. XXXVII. fig. 5; Pl. XXXVIII. figs. 10, 19; Pl. XLV. figs. 42, 44; Pl. XLVI. figs. 50, 53—55).

Locality, etc. Hulule, Maldive Is. From boulder zone under stones in sand. Also from sand at Minikoi in company with *Pt. flava,* var. *laccadivensis.*

With reference to the specimens from Hulule Mr Stanley Gardiner has made the following note:—"They are found sparingly under the stones of the boulder zone in the sand. A couple of specimens or more can almost invariably be obtained wherever a large grey Actinian lives, the latter seeming to protect the Enteropneusts. Polychaets, Sipunculids, and Holothurians are not generally found in the same patch of sand."

External features. This is a small variety, the longest specimen of which measured 68 mm. after preservation, the shortest 32 mm. (see Table 12, p. 673). It is somewhat slenderly built though the total length in comparison with that of the collar averages 19·6. The posterior portion of the animal's body is usually very slender (cf. Pl. XXXVII. fig. 5) though this is not so much the case in larger specimens. The liver saccules shew an anterior dark group and a more extensive posterior lighter group. The saccules are not large (Pl. XXXIX. fig. 19) and are as a rule not at all or but slightly lobulated except in the case of large specimens (Pl. XXXIX. fig. 10, ✣). In the specimen from which the coloured sketch (Pl. XXXVII. fig. 5) was made all the liver saccules appear dark. It is possible that it is only after preservation that the darker anterior group can be separated from the rest.

Internal structure.

Proboscis. The musculature is rather feebly developed, the longitudinal fibres being gathered into widely separated radial bundles as in *laccadivensis* (cf. Pl. XXXIX. fig. 25). The dorsal muscular decussation may be feebly developed or fairly strong. Dorso-ventral proboscis muscles are present anterior to the pericardium. The ventral proboscis septum is well-developed, reaching almost to the tip of the stomochord. Of the paired proboscis pores only one is functional, placing the dorsal coelom in communication with the exterior. This may be either on the right or left side. The other pore is generally smaller and in one case had disappeared altogether. The racemose organ is well-marked though unlobulated or only faintly so.

Collar. The musculature of the collar, like that of the proboscis, is somewhat feebly developed. The cavity in the anterior part of the collar is very spacious. The intra-collar lumen of the œsophagus is unusually large (Pl. XLV. fig. 42). The dorsal collar septum is present as usual behind the first root. The ventral septum may be found at the hind end of the collar or it may be absent.

TABLE 4.

Pt. flava, var. *gracilis*.

No. of specimen	(1)	(2)	(3)	(4)	(5)
Proboscis coelom	Fairly large	Not large	as (2)	Spacious	as (1)
Collar coelom	Spacious	as (1)	as (1)	as (1)	as (1)
Ventral proboscis septum	Nearly to tip of stomochord	as (1)	as (1)	as (1)	as (1)
Dorso-ventral proboscis muscles	Present	as (1)	as (1)	—	—
Dorsal collar septum	Complete after 1st root	as (1)	as (1)	as (1)	as (1)
Ventral collar septum	Traces only	as (1)	Absent	as (3)	Complete at hind end of collar
Racemose organ	Well marked but small and unlobulated	Well marked. Unlobulated	Well marked. Slightly lobulated	as (1)	as (1)
Dorsal proboscis muscle decussation	Fairly well marked. No ventral circular muscles	Not very marked. No ventral circular muscles	Well marked. No ventral circular muscles	Very feeble. No ventral circular muscles	as (1)
Dorsal roots	*RR	RRr	RRR	RRr	RRr
Proboscis pores	*lR	Lr	lR	lR	L only
Nerve cord	Lumen continuous	as (1)	as (1)	as (1)	as (1)
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	·11	·11	·10	·16	·15
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	17·4	19·0	11·3	15·5	14·1
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	1·26	1·14	1·00	·60	·85
Synapticula	Not more than 9	Not more than 7	Not more than 7	—	Not more than 7

The collar cord exhibits a continuous lumen throughout. Three roots are usually to be found. The cornua of the nuchal skeleton are rather shorter than usual, extending over about $\frac{1}{6}$—$\frac{1}{7}$ of the collar length.

* See foot-note on p. 645.

Trunk. The branchial region in this variety is very short, averaging only a quarter as much again as the collar length (see Table 12, p. 673). In the Maldive specimens the branchial part of the œsophagus is at least as large and generally somewhat larger than the ventral portion. In the Minikoi specimens on the other hand it is somewhat smaller, a feature in which they approximate to *laccadivensis*. The post-branchial groove is very short in the specimens from Hulule, not being more than about $\frac{1}{10}$ of the length of the short branchial region. In the Minikoi specimens it is rather longer. The genital pleurae are large in the branchial region (Pl. XLVI. figs. 50, 54). They diminish in size considerably in the region of the post-branchial groove (Pl. XLVI. figs. 53, 55), after which they are very small.

The proportions of the various regions of the body in the above account have been determined from an examination of 28 specimens from Hulule (*vide* Table 12, p. 673). Five specimens only were procured from Minikoi and, as will be seen in Table 4, Nos. 4 and 5, these differ somewhat from the Hulule forms. It is possible that examination of a larger amount of material may shew that these Minikoi specimens belong to a distinct variety. The difference in their mode of occurrence (p. 651) would seem to point the same way, but in any case they are very closely related to the Hulule form.

Ptychodera flava, var. **muscula** (Pl. XLII. fig. 18).

Locality, etc. A Maldive form from Goifurfehendu Atoll, Goidu. It was obtained from the sandy shore to the east of the island in the sand below the weed and under some square slabs of beach sandstone. In company with it was found *Spengelia porosa*. About a dozen specimens procured in all.

External features. Colour in life pale yellow with very black hepatic region. A small form with a total length after preservation of 31—48 mm. Average length compared with collar as unity = 15·6. A somewhat short and stoutly built form, generally speaking. The anterior hepatic caeca are, after preservation, darker than the rest.

Internal structure.

Proboscis. The internal longitudinal musculature is very strongly developed and closely surrounds the central complex, almost obliterating the proboscis cavity. No dorso-ventral muscles anterior to the pericardium. The ventral proboscis septum is short and does not reach nearly to the tip of the stomochord. Of the paired proboscis pores one may not be functional. The racemose organ may be small or fairly well marked and slightly lobulated. The nuchal skeleton has a well-developed keel which gives off a flattened expansion over the racemose organ. Such an expansion occurs generally in the genus but is not usually so well-marked as in the present variety (Pl. XLII. fig. 18). A strong dorsal muscular decussation occurs in the anterior portion of the proboscis, and from it pass some circular fibres ventrally.

Collar. The musculature of this region also is well developed. The cavity in the anterior part of the proboscis is comparatively large. The dorsal septum is found as usual after the first root though it may not immediately be complete. The ventral septum is absent or traces of it only are to be found.

The lumen of the nerve cord shews a marked tendency to become occluded. Three or four dorsal roots may be present.

TABLE 5.

	Pt. flava, var. *muscula*.		*Pt. flava*, var. *cooperi*.		*Pt. viridis*.	
No. of specimen	(1)	(2)	(1)	(2)	(1)	(2)
Proboscis coelom	Very small	Small	Spacious	Small	Very small	Small
Collar coelom	Spacious	Fairly large	Very spacious	as (1)	Small	Very small
Ventral proboscis septum	Not nearly to tip of stomochord	as (1)	Not nearly to tip of stomochord	as (1)	Not nearly to tip of stomochord	Not quite to tip of stomochord
Dorso-ventral proboscis muscles	Absent	as (1)	Absent	as (1)	Absent	as (1)
Dorsal collar septum	After 1st root. Not complete	After 1st root complete	Complete after 1st root	as (1)	Complete after 1st root	After 1st root but not at once complete
Ventral collar septum	Traces	Absent	Absent	Traces in extreme hind end of collar	Complete at extreme hind end of collar	Traces
Racemose organ	Very small	Well marked. Slightly lobulated	Well marked. Unlobulated	as (1)	Large. Unlobulated	Large and slightly lobulated
Dorsal proboscis muscle decussation	Strong with ventral circular fibres	as (1)	Feeble. No ventral circular muscles	Moderately developed. No ventral circular muscles	?	Strong with a few ventral fibres
Dorsal roots	*RRR	RRrr	R	Rr	RRr	?
Proboscis pores	*Lr	LR	lR	R	?	LR
Nerve cord	Lumen with tendency to obliteration	as (1)	Lumen with tendency to obliteration	as (1)	Lumen completely obliterated	as (1)
Length of post-branchial groove / Length of branchial region	—	14·5	·12	·15	Very short and insignificant	as (1)
Length of cornua × 100 / Length of collar	14·0	15·8	45·5	53·7	16·1	27·8
Circumference of branchial œs. / Circumference of œsoph. œs.	·78	·81	1·19	1·13	1·02	·95
Synapticula	—	—	Not more than 8	Not more than 7	—	—
Length of branchial region / Length of collar	—	1·30	2·23	2·06	·85	1·44

* See foot-note on p. 645.

The cornua of the nuchal skeleton are short, extending over less than $\frac{1}{6}$ of the collar length.

Trunk. The branchial region is fairly long, averaging more than double the length of the collar in 10 specimens (see Table 12, p. 673). In one small specimen only was it less than double the length of the collar. On the whole it is remarkably constant in length. The branchial division of the œsophagus is considerably less than the ventral portion. The post-branchial canal was found to be short in the specimen examined, being less than $\frac{1}{6}$ of the length of the branchial region. The post-branchial pre-hepatic genital tract is comparatively short. The genital pleurae are well-developed.

Ptychodera flava, var. **cooperi** (Pl. XXXVIII. fig. 12; Pl. XLV. figs. 45—47).

Locality, etc. Two specimens, both somewhat imperfect, from N. Male Atoll. Dredged in 5 fathoms on a sandy bottom within the velu of Jaro near Helengeli.

External features. A small form with a maximum breadth in the collar and branchial region of less than 3 mm. Behind the hepatic region the diameter of the animal is only a trifle over 1 mm. In the preserved specimens the collar and proboscis are both very short, their width being greater than their length (Pl. XXXVIII. fig. 12). The genital pleurae are large in the branchial region, which is rather more than double the length of the collar. The genital region between the termination of the branchial and the commencement of the hepatic caeca is relatively long. The hepatic caeca are short but well-developed, and on their inner sides are lobulated. There is no distinction into lighter and darker ones.

Internal structure.

Proboscis. The cavity of the proboscis is well-developed in one specimen, whilst in the other it is small. The radial arrangement of the muscles is not so conspicuous as in most members of the genus. Dorso-ventral muscles anterior to the pericardium are not present, and the ventral proboscis septum is very short. The right proboscis pore in each case places the dorsal coelom in communication with the exterior. The left pore is present in one specimen but absent in the other. The racemose organ is well-marked but unlobulated. The keel of the nuchal skeleton is somewhat larger than usually obtains in the species (Pl. XLV. fig. 45). The skeleton is altogether massive (Pl. XLV. fig. 46).

Collar. The cavity in the anterior part of the collar is very spacious. Posterior to it the collar musculature is unusually strongly developed, a fact which may in some measure account for the extreme shortening of this region on preservation. The dorsal septum is as usual complete after the first root. A ventral septum was completely absent in one specimen though traces of it occurred at the extreme hind end of the collar in the other. In one case a single dorsal root reaching to the epidermis was found. In the second specimen this was supplemented by a rudimentary one. The lumen of the collar cord shews a tendency to occlusion behind the level where the roots come off.

A noteworthy feature of this variety is the condition of the nuchal cornua which extend back to the hind end of the collar, the tip of them being found in sections which also pass through the first branchial bars. Such a condition is most unusual amongst the Ptychoderidae, recalling that recently described by Ritter (**'00,** p. 113) for *Harrimania maculosa.*

Trunk. The branchial portion of the œsophagus is rather larger than the ventral portion. Seven to eight synapticula are present. The post-branchial groove is large (Pl. XLV. fig. 47),

whilst the œsophagus at this level is very small. The genital pleurae are still large in this region but become much reduced shortly after it.

Ptychodera viridis, n. sp. (Pl. XXXVII. figs. 2, 6, 7; Pl. XXXIX. fig. 32; Pl. XLII. figs. 17 and 19).

Locality, etc. From Hulule, Maldive Is. Three specimens only, two being complete, were dug from sand towards the east of the island.

External features. Coloured sketches from life of this worm were fortunately made by Mr Forster Cooper. From the reproductions of these on Plate XXXVII. it will be seen that green is the prevailing tint on the body of the animal, though the proboscis is pale yellow, and the collar pale yellow with a certain amount of orange. To the predominant body tint the animal owes its specific name. From the sketches it appears that the proboscis is considerably longer than the collar, a proportion which still exists in the preserved creature. The length is not great. Of the two complete specimens one measured 36 mm. and the second only 21 mm. in length after preservation (ratio of total length to collar length being respectively 18 : 1 and 14 : 1). Compared therefore with such forms as *Pt. flava,* var. *laccadivensis,* this species is a small, short, and somewhat stunted form. The genital pleurae are well-developed. The external liver saccules are relatively feebly developed and are of a uniform colour.

Internal structure. The musculature of the proboscis is strong and compact, the radial bundles into which the longitudinal muscles are gathered being closely connected by connective tissue. The powerful development of the longitudinal muscles leads to the practical obliteration of the proboscis cavity (Pl. XXXIX. fig. 32). A well-marked dorsal muscular decussation occurs in the anterior part of the proboscis (Pl. XXXIX. fig. 32, *dmd*) and fibres from it pass ventral to the central complex. Dorso-ventral muscles anterior to the pericardium are not present. The ventral proboscis septum reaches forwards almost to the tip of the stomochord. The racemose organ is small and unlobulated. Both proboscis pores are present though only one is in functional communication with the dorsal proboscis coelom. This may be either the right or the left one.

Collar. The musculature and the connective tissue are here strongly developed and the cavity of the collar is very much reduced. The dorsal septum occurs after the first root as usual and is generally complete. Traces of the ventral septum may occur. The lumen of the collar cord is almost entirely obliterated throughout and the cord in section has as great a dorso-ventral diameter as a lateral one (Pl. XLII. fig. 19). In one of the specimens sectioned three roots were present of which the last was rudimentary.

The cornua of the nuchal skeleton apparently vary much in length. In one specimen they extended over about $\frac{1}{6}$ of the collar, whilst in another they were rather more than a quarter as long as this structure.

Trunk. The branchial region is short. Compared to the collar length as unity it measured in the three available specimens ·85, 1·00, and 1·44, giving an average of 1·10. The branchial portion of the œsophagus is approximately of the same size as the ventral portion. The post-branchial groove is very short and insignificant. The genital folds are large in the branchial region and also in the region of the post-branchial groove (Pl. XLII. fig. 17).

Ptychodera asymmetrica, n. sp. (Pl. XXXVII. figs. 1 and 9; Pl. XLVI. figs. 52, 56, 58).

Locality, etc. From Hulule. According to Mr Stanley Gardiner, "Near the south islet is a pool with loose rocks well within the boulder zone. This form was found here in accumulations of sand under stones. They are remarkable in life for the enormous quantity of mucus they secrete, so much indeed that it is almost impossible to obtain them clean for preservation." About 10 specimens were procured, mostly somewhat fragmentary.

External features. A small form measuring on the average about 40 mm. in length (Pl. XXXVII. fig. 1). One larger specimen, a sketch of which was made by Mr Forster Cooper and is reproduced on Pl. XXXVII. fig. 9, measured after preservation 60 mm. in length with a collar 3 mm. long. This specimen however was unusually large. Two points about its external appearance merit attention. In the first place the liver saccules are somewhat small and uniformly dark in colour. There is no sharp line of demarcation between an anterior set of very dark caeca and a posterior set of lighter ones as in *Pt. flava*, var. *laccadivensis*. In the second place careful examination shews that the left genital pleura is always somewhat larger and more swollen than the right one. In all the eight specimens examined by me the gonads shew asymmetry by being developed only on the left side. This was the case both in a very young specimen with quite immature gonads, and also in the large specimen above alluded to in which the gonads were full of ripe spermatozoa. In his account of *Pt. flava* Willey (**'99,** p. 240) mentions a case in which the gonads were only developed in the right genital pleura, those in the left being apparently in a state of arrested development. Evidently with the case of *Asymmetron* in his mind Willey writes, "Such a differential behaviour of the two sides of the body is of interest as indicating a tendency to unilaterality in the matter of the gonads." Spengel (**'03,** p. 305) criticises this remark of Willey's, regarding such a condition as produced by the presence of a parasitic copepod, *Ive sp.* In the two cases examined by Spengel where the gonads of one side were undeveloped the parasite occurred in the genital pleura of that side, and there seems little doubt that Spengel's explanation is here correct, and that the condition is a pathological one. But there can be no doubt that this explanation will not hold for *Pt. asymmetrica*. The fact that in eight cases, in different stages of growth, gonads were always absent from the right pleura, coupled with the fact that no parasite was to be found, seems to shew beyond all question that unilaterality of the gonads is a feature which is characteristic of this species.

Internal structure.

Proboscis. The longitudinal muscles do not exhibit a markedly radial arrangement of bundles. They are strongly developed and almost entirely fill the cavity of the proboscis so that there is no space, or only a very small one, between them and the central complex. There are no dorso-ventral muscles in front of the pericardium. The ventral proboscis septum does not reach to the tip of the stomochord and is often much shorter.

The racemose organ is subject to considerable variation. It may be small and unlobulated, large and lobulated or not.

There is usually a well-marked dorsal muscular decussation in the anterior part of the proboscis though no circular fibres pass from it ventrally.

Collar. The cavity of the collar varies considerably. It is on the whole not large and may be almost absent. The collar musculature is well-developed. The dorsal septum

is always complete after the first root. The ventral septum is a more conspicuous structure in this species than in most others of the genus. It is always found in the posterior part of the collar and may reach forwards over $\frac{1}{3}$ of the collar length.

TABLE 6.

Pt. asymmetrica.

No. of specimen	(1)	(2)	(3)	(4)	(5)
Proboscis coelom	Very small	as (1)	Well marked but small	as (1)	Obliterated by muscles
Collar coelom	Much reduced	Almost obliterated	Fairly spacious	Very small	Well marked
Ventral proboscis septum	Short. Not nearly to tip of stomochord	Not to tip of stomochord	Not quite to tip of stomochord	as (3)	as (1)
Dorso-ventral proboscis muscles	Absent	as (1)	as (1)	as (1)	as (1)
Dorsal collar septum	Complete after 1st root	as (1)	as (1)	as (1)	as (1)
Ventral collar septum	Complete in hind end of collar	as (1)	as (1)	as (1)	Complete in posterior $\frac{1}{3}$ of collar
Racemose organ	Large but unlobulated	Large and lobulated	as (1)	Small and unlobulated	Very large and lobulated
Dorsal proboscis muscle decussation	Well marked. No ventral circular muscles	as (1)	as (1)	Not well marked. No ventral circular muscles	as (1)
Dorsal roots	*RRR	RRrr	RR	R	RR
Proboscis pores	*LR	Lr	lR	lR	lR
Nerve cord	Lumen almost obliterated	Lumen distinct in places	Lumen distinct in places. Strong tendency to obliteration	as (1)	as (1)
$\frac{\text{Length of post-branchial groove}}{\text{Length of branchial region}}$	·23	—	·18	·24	—
$\frac{\text{Length of cornua} \times 100}{\text{Length of collar}}$	24·5	20·9	47·3	40·5	25·7
$\frac{\text{Circumference of branchial œs.}}{\text{Circumference of œsoph. œs.}}$	·98	1·08	1·04	—	1·06
Synapticula	—	—	Not more than 5	—	—

The lumen of the collar cord is never continuous throughout. It may be present as a number of small cavities much broken up, or it may be practically absent, the cord shewing

* See foot-note on p. 645.

only the merest traces of a lumen. As is often the case with the collar cord, when the lumen shews a marked tendency to occlusion, the dorso-ventral diameter as seen in transverse section tends to become relatively great as compared with the transverse diameter (Pl. XLIV. fig. 29). The number of the dorsal roots is very variable. There may be as few as one, though four seems to be the maximum.

The cornua of the nuchal skeleton are on the whole long for members of this genus, but shew a considerable amount of variation. They may extend over only $\frac{1}{5}$ of the collar length, or their length may be equal nearly to $\frac{1}{2}$ that of the collar.

Trunk. The branchial portion of the œsophagus is of about the same size as the ventral part. The relative length of the branchial region as compared with the collar length is short, it being seldom more than half as long again as the latter and sometimes even less. In the large specimen figured on Pl. XXXVII. fig. 9, however, it was rather more than three times the collar length.

The post-branchial groove on the other hand is longer than usual, averaging between $\frac{1}{5}$ and $\frac{1}{4}$ the length of the branchial region.

The genital folds are somewhat small (Pl. XLVI. figs. 52 and 56) and become mere ridges in the region of the post-branchial groove (Pl. XLVI. fig. 58).

SOME ANATOMICAL POINTS.

As Spengel in his latest publication (**'03**) differs on one or two points from Willey it may be worth devoting a few lines to them. In two of these cases, the pygochord and the lateral septa, I find myself in agreement with Spengel rather than Willey.

The **pygochord** is a structure on which Willey has laid some stress, describing it as "a longitudinal, solid, supporting band" (**'99,** p. 243), and evidently seeing in it a skeletal structure for the support of the caudal region. On the ground of its minute proportions Spengel (**'03,** p. 317) dissents from Willey's interpretation, and one cannot help agreeing with Spengel in refusing to regard such a small and rudimentary structure as of any importance from this point of view. As Spengel remarks we have absolutely no knowledge of the function of this apparently vestigial structure, and it is with some diffidence that I venture to suggest that it may be the remains of a ventral siphon which was at one time of functional importance but now vestigial. The occurrence of such a siphon, whatever may be its exact function, is common among sand-feeding animals. Similar structures occur in the Echinoidea, in the Capitellidae, and in certain Chaetopoda such as *Thallasema* and *Echiurus* —all creatures which derive their nutriment from among the large quantities of sand continually passing through the alimentary canal. The condition of the pygochord found in a specimen of *Pt. saxicola* is interesting in this connection. The structure in question was here connected at either end with the intestine whilst for the middle part of its course it was entirely free (cf. Pl. XLIV. figs. 35—37), a condition strongly suggestive of a collateral intestine.

The **lateral septum** is described by Willey as passing to the epidermis at the base of the genital pleurae in the post-branchial region (**'99,** Pl. XXIX. fig. 14). Spengel, however, finds that this is not so, but that it ends at the lateral blood vessel (**'03,** p. 297). It is sufficient to remark that on this point I find myself in agreement with Spengel.

Lastly there is a point in connection with the **branchiae** which calls for short notice. It has been assumed that the main function subserved by these structures is that of respiration, and in the figures given by most authors the blood vessels form a prominent feature. Nevertheless the course of the branchial circulation is a point which has never been satisfactorily cleared up (cf. Delage and Herouard, **'98,** p. 41), and in looking through numerous series of sections through the branchial region I have been struck by the infrequency with which one finds any blood in these structures. On the other hand the sub-epidermal vascular plexus is exceedingly well-developed everywhere and it is difficult to avoid the conclusion that respiration is mainly, if not entirely, carried out by the large skin area, whilst the main function of the gills is to act as a sieve for straining off the water from the mixture of sand and water continually swallowed by the animal.

THE FORMATION OF THE GONADS.

The origin of the gonads is a subject on which widely diverse views have been upheld by different observers. Bateson (**'86**) attributed to them an ectodermal origin, Spengel (**'95**) regards them as being developed in a blood space, whilst Morgan (**'94,** p. 60) holds that they are formed from the mesodermal elements of the coelom. The question is one of considerable difficulty and none of the above observers has made out a very strong case in support of his view. Bateson bases his belief on the early connection apparent between the gonad and the ectoderm (**'86,** Pl. XXXII. fig. 110). Spengel considers this connection to be due to the precocious formation of a duct and claims to have found sex cells at a very early stage of development inside the blood vessels (**'95,** Pl. II. figs. 27 and 28). He finds additional support for his view in the fact that in a small specimen[1] of *Pt. flava*, var. *laysanica*, the "Anlage" of the gonad first appears between the two lamellae of the lateral septum (**'03,** p. 302). The case which he has made out is far from convincing since it is by no means certain that the small cells which he regards as primitive sexual cells are of that nature, whilst on the other hand there are good grounds for looking upon the lateral septum as composed of four rather than of two lamellae (see below, p. 661). Lastly Morgan's contention as to the mesodermal origin of the gonads is not borne out by his figures. In the earliest stage figured by him (**'94,** Pl. VI. fig. 79) the gonad is obviously in continuity with the ectoderm, a connection which, to judge by his figures, is very soon lost, though doubtless re-established later on the formation of the genital ducts. The question of the ectodermal origin of the gonads turns largely upon the interpretation of the ectodermal connection found at different stages of their development. In other words, has the gonad an ectodermal connection at two different stages of its growth, the earlier representing the ingrowth of ectoderm to form the gonad, whilst the latter represents the functional duct? From the following observations on *Pt. flava* I am inclined to believe that such is the case. As the gonads appear to develop earlier in some varieties than in others I have considered them apart with the following results.

(1) Var. *laccadivensis*. The youngest stages of the gonads were met with in a very small specimen about 15 mm. long. The young gonads are in many places in connection with the ectoderm (Pl. XL. fig. 36). In the region of the genital pleurae this connection

[1] Judging from the regenerated material at my disposal in the case of *Pt. flava*, var. *laccadivensis*, I have very little doubt in considering this small specimen of Spengel's to be a regenerated one.

is almost invariably found where the lateral septum joins the basement-membrane at the tip of the pleura. Occasionally an ingrowth from the ectoderm of the inner surface of the pleura is to be seen, but this is rare. The irregular occurrence of the ectodermal connections and their somewhat attenuated condition seems to indicate that they are in process of disappearance. And this supposition is borne out by the fact that in somewhat older specimens the gonads are devoid of any ectodermal connection.

(2) Var. *saxicola*. Though all the specimens of this variety were of fair size the gonads in all are in a very backward state of development. The gonads are in all cases young and in all cases possess a more or less well-marked ectodermal connection. This connection is relatively wider in the younger gonads (cf. Pl. XL. figs. 41 and 42). A still younger stage of an ectodermal ingrowth at the tip of a genital pleura is shewn on Pl. XXXIX. fig. 31. There can be little question but that this is of the nature of an ingrowth, and indeed rounded cells may be seen in it, which are not to be found in other parts of the ectoderm, and which are probably to be regarded as primitive genital cells. The main ingrowth is that at the tip of the pleura as in var. *laccadivensis*, but the accessory ingrowths on the inner surface of the pleurae are much more numerous in *saxicola*, a fact probably correlated with the larger size attained by the animal for a similar stage of gonidial development. Unfortunately none of the four specimens of this variety possessed older gonads.

(3) Var. *muscula*. In a specimen with immature and somewhat small gonads an ectodermal connection is generally wanting. It may be present here and there. In an older specimen in which spermatocytes could be recognized in the gonads (Pl. XL. fig. 37) the ectodermal connections are present on almost all the gonads.

(4) Var. *maldivensis*. This variety is characterized by often having long slender genital ducts. They are found connected with fairly well-developed gonads and in some cases I have been able to make out their double origin, in part from an ectodermal ingrowth and in part from an outgrowth from the gonad. In one or two instances the two portions had not effected a junction, a condition supporting the view that the true genital ducts are late in making their appearance. It has already been noticed that the ectodermal ingrowths near the tip of the pleurae always occur directly over the point where the lateral septum joins the basement-membrane and pass down between its lamellae. On the other hand the ducts in connection with the gonads nearest the tip of the pleurae may be entirely independent of the lateral septum (Pl. XXXIX. fig. 27).

All the above observations are in harmony with the view that the gonads are (in *Pt. flava* at any rate) derived from ectodermal ingrowths, that they subsequently lose their connection with the ectoderm, but regain it later when the genital ducts are established. Further, on this view we can explain the lateral septum of the Ptychoderidae, regarding it as having in the first place been brought about by the basement-membrane being carried in by the primitive ectodermal ingrowths at the tip of the pleurae (at that time probably very much smaller). On this view the lateral septum should be four-layered since the basement-membrane consists already of two layers enclosing blood spaces. That four potential layers are present is shewn by the fact that the apparently single layer round the gonad is in reality a double one since blood spaces frequently occur in it (Pl. XL. fig. 41). The cavity of the gonad is therefore quite distinct from the blood spaces, which militates against Spengel's view of the nature of the gonad.

The gonads of *Ptychodera flava* are characterized by the presence of peculiar bodies

apparently devoid both of structure and of nucleus. The origin of these bodies, the "fettartig Kügelchen" of Spengel and the "eosinophil globules" of Willey, is somewhat obscure. Willey holds that they are the products of nuclear degeneration accompanied by hypertrophy of the nucleolus. Spengel (**'03,** p. 306) refuses to believe that they are the outcome of degenerative changes. In the young specimen of *Pt. laccadivensis* referred to above I have been able to follow what seems to be the history of these bodies. Certain of the spindle-shaped mesodermal cells become first oval and then more or less spherical in shape (Pl. XL. fig. 38, *a*—*b*), at the same time increasing slightly in bulk. A few granules make their appearance in the hitherto clear cytoplasm. A little later these cells appear to collect together in clusters of about 6—10 (fig. 38, *c*), which subsequently fuse together to form giant cells packed with granules and with the nuclei degenerating (fig. 38, *d* and *e*). Later the nuclei disappear and the giant cells apply themselves close to the gonad. Where this occurs the wall of the gonad seems to break down and by some method which is not clear the nutriment stored in the giant cells is transferred to the interior of the gonad where it loses its granular appearance (cf. Pl. XL. fig. 37). At later stages small round corpuscles of an eosinophil nature also make their appearance in the mesoderm and subsequently apply themselves to the gonads in a similar manner (Pl. XL. fig. 41). The chief interest of the process seems to lie in the fact that although the sexual cells themselves are derived from the ectoderm[1], it is the mesoderm which provides them with nourishment and which contributes the yolk to the eggs.

The above account is of interest when it is considered with reference to our conception of the nature and properties of the coelom. According to present ideas one of the chief functions of the coelom is to give rise to the generative cells from the epithelium which lines it. Further it is usually held that the most primitive method of formation of the coelom is that of archenteric diverticula. In animals like the Enteropneusta, where this method of the formation is found, we should naturally look for genital cells arising from its lining. That this is not so may cause us to regard with some reservation the statement that the coelom was originally a gonocoel[2], and to consider it rather as an organ specialized, among other things, for the reception and maturation of the genital cells.

VARIATION IN *PTYCHODERA FLAVA*.

The different varieties of *Pt. flava* are by no means easy to distinguish from one another after preservation. An adequate examination of the characters which are of systematic value involves the preparation of a large number of serial sections. If a trustworthy criterion based upon external features alone could be found much labour might be spared the Enteropneustic systematist. The large amount of material collected by Mr Stanley Gardiner has enabled me to attempt this.

The characters upon which such a criterion might be based must satisfy two conditions; (1) they must be capable of easy measurement, and (2) they must be independent of the

[1] In this connection it is interesting to notice that so long ago as 1885 Hubrecht described the ectodermal origin of the gonads in the Nemertean *Lineus gesserensis*. He was able here to distinguish with certainty the primary ectodermal connection from the later formed duct (Hubrecht, **'85,** Pl. v. figs. 88 and 89).

[2] For the most recent general account of the coelom the reader may be referred to Lankester's *Treatise on Zoology*, 1900, Pt. II. chap. II.

growth of the animal. This latter condition precludes the direct use of absolute measurements. It is obvious that a ratio must be made use of—a simple ratio whose two factors are equally affected by growth changes. Though several distinct regions may be distinguished in the body of a *Ptychodera*, with the exception of the collar and branchial region, their limits are not very clearly defined. Accordingly most attention has been paid to the ratio of branchial to collar length. And this more especially since any collection of Enteropneusts will be largely made up of damaged specimens, and though few specimens may attain to anything like completeness, yet in the great majority both collar and branchial regions will be perfect. Great accuracy in the measurement of such animals as the Enteropneusta is out of the question since in a soft-bodied creature relative differences in the state of contraction of the various body regions may easily occur, whilst the personal equation must enter largely into the result. In the present instance however all the material had been treated in the same way, *i.e.* had been narcotised in chloral hydrate for several hours before preservation, thus ensuring an equable contraction, whilst the personal equation was as far as possible eliminated by my making all the measurements within the space of a week or so.

By far the most frequent of the varieties described in this paper is *laccadivensis*, and it is here that the measurements are most complete. In addition to the length of the collar and of the branchial region the total length and the length of the genito-hepatic regions was measured wherever the specimen was sufficiently perfect. The width of the collar was also registered. The results for 123 specimens (fewer in the case of the genito-hepatic and total lengths) are given in Table 11, pp. 671—2, and in the diagram on p. 666. Before however any value can be attached to these figures it must be shewn how, if at all, growth affects these ratios.

The method employed for estimating growth changes was to divide the animals into several groups according to size, and to calculate the above three ratios for each group separately. As the collar width was sometimes less, sometimes greater, than the length it was thought advisable to take this factor also into account, and in the case of *laccadivensis* the following groups were made.

	Numbers in Group		
	Branchial	Genito-hepatic	Total
Group 1. Collar length × breadth not > 16	47	38	19
„ 2. „ „ × „ > 16, but not > 25...	45	33	17
„ 3. „ „ × „ > 25, „ „ > 36...	27	15	13
„ 4. „ „ × „ > 36	4	—	—
	123	86	49

The mean of each ratio was then calculated for each of the above groups with the following result:—

$\frac{\text{Branchial length}}{\text{Collar length}}$		No. of Specimens
Mean for Group 1 =	2·08	47
„ „ „ 2 =	2·18	45
„ „ „ 3 =	2·36	27
„ „ „ 4 =	2·77	4
Average	2·20	

		No. of Specimens
$\frac{\text{Genito-hepatic length}}{\text{Collar length}}$.	Mean for Group 1 = 4·94	38
	" " " 2 = 4·90	33
	" " " 3 = 4·84	15
	Average 4·90	
$\frac{\text{Total length}}{\text{Collar length}}$.	Mean for Group 1 = 23·1	19
	" " " 2 = 22·4	17
	" " " 3 = 23·4	13
	Average 22·9	

An examination of the above table brings out clearly the important fact that two of the three ratios, *i.e.* those of the genito-hepatic and total lengths, are quite unaffected by growth changes, whilst that of the branchial region is not greatly affected. Neglecting group 4 in which there are so few specimens there is a gradual rise in the ratio with increase in size from 2·08 in group 1 to 2·18 in group 2, and 2·36 in group 3. There is therefore an increase of about 12 °/₀ in group 3 as compared with group 1, an increase sufficiently well-marked though not very great when we take into account the unavoidable roughness of the measurements. A possible source of error must be noticed here. A considerable number of specimens (some 8—10 °/₀) were regenerating. Where this process was obviously at work the specimens were not included in the above measurements. In the latest stages, however, regenerated individuals are impossible to distinguish from ordinary ones with a somewhat shorter branchial region than usual. As regeneration is far more common in the smaller specimens it seems almost certain that the values of the ratio for groups 1 and 2 are somewhat too low in comparison with those of group 3. On the whole it would appear from these measurements on *laccadivensis* that the proportions of the body of this Enteropneust are very little, if at all, liable to alteration during the later stages of growth.

This conclusion is borne out by a similar series of measurements made on *Pt. flava*, var. *maldivensis*. The 52 specimens of this variety were divided into three groups of which the last contained only the five largest specimens (see Table 13, p. 674). On taking the mean for the three ratios in each group the following figures were obtained.

TABLE 7.

		No. of Specimens
$\frac{\text{Branchial length}}{\text{Collar length}}$.	Mean for Group 1 = 1·65	19
	" " " 2 = 1·62	28
	" " " 3 = 2·00	5
	Average 1·67	
$\frac{\text{Genito-hepatic length}}{\text{Collar length}}$.	Mean for Group 1 = 4·58	19
	" " " 2 = 4·14	28
	" " " 3 = 5·23	5
	Average 4·41	
$\frac{\text{Total length}}{\text{Collar length}}$.	Mean for Group 1 = 16·5	6
	" " " 2 = 18·7	9
	" " " 3 = 17·6	2
	Average 17·7	

There is more irregularity here in the figures for the genito-hepatic length and total length, which perhaps is only to be expected in view of the smaller number of specimens. There is however no uniformity indicating a growth change. The value for group 3 in the branchial series is far larger than for groups 1 and 2. This however is due to the large branchial region of a single specimen (Table 13, No. 49) and its effect on the few individuals of group 3. The closeness of the figures for groups 1 and 2 (1·65 to 1·62), where there are more specimens available, points to the ratio of branchial length to collar not being affected by growth changes. Assuming then, and the assumption seems a fair one, that growth has little or no effect on the relative proportions of the body in *Ptychodera* we have before us an easily applied criterion for distinguishing different positions of organic stability in this genus. We have but to determine one of these ratios (and in practice the branchial one will be found the most convenient) on a number of specimens of each supposed variety, and to apply to the series so obtained the ordinary biometric methods for measuring the variability. Marked differences occurring in two groups of specimens would at once cast a doubt on the identity of two such groups.

This method has been adopted here for such of the varieties as possessed nine or more specimens. The branchial ratio alone was used owing to the fragmentary condition of most of the individuals in each variety. On working out the mean and standard deviation in each case the following results were obtained:—

TABLE 8.[1]

	Pt. laccadivensis (Minikoi)	*Pt. maldivensis* (Maldives)	*Pt. muscula* (Goidu)	*Pt. gracilis* (Hulule)	*Pt. parva* (Turadu)
M.	2·263	1·630	2·225	1·259	1·514
P. E. M.	± ·1405	± ·1724	± ·2484	± ·1995	·1753
σ	±2·3098	±1·8431	±1·1647	±1·5656	·7798
P. E. σ	± ·0993	± ·1219	± ·1757	± ·1411	·1240
C. V.	102·07	113·08	52·35	124·35	51·50
N.	123	52	10	28	9

These results shew clearly that in certain cases we are without doubt dealing with different races[2] of *Pt. flava*. Thus the two forms *laccadivensis* and *maldivensis* are exceedingly alike both in external appearance and in internal structure. The branchial ratio is however very different, the mean for *maldivensis* (1·63) being very much lower than that (2·26) for *laccadivensis*. And the difference between the two is almost four times the probable error of either, from which it may be calculated that the odds are many thousands to one against its being due to errors of random sampling alone.

[1] For the actual measurements on which these figures are based see Tables 11—13, pp. 671—4. Of the letters in the above Table (*i.e.* Table 8), M. = mean; P.E.M. = probable error of the mean; σ = standard deviation; P.E.σ. = probable error of standard deviation; C.V. = coefficient of variation; whilst N. = number of specimens in each case.

[2] I am not here concerned with the question of the statistical method as a criterion of species and variety (cf. Davenport, C., *Statistical Methods*, 1899, p. 38). My point is that in the group of animals collectively designated *Pt. flava* there are to be found different positions of organic stability, and in giving to these "a local habitation and a name" there is no thought of distinguishing by statistical methods between the terms, *race*, *variety*, and *species*. For the value attached to such distinctions must for the present be largely a matter of individual taste.

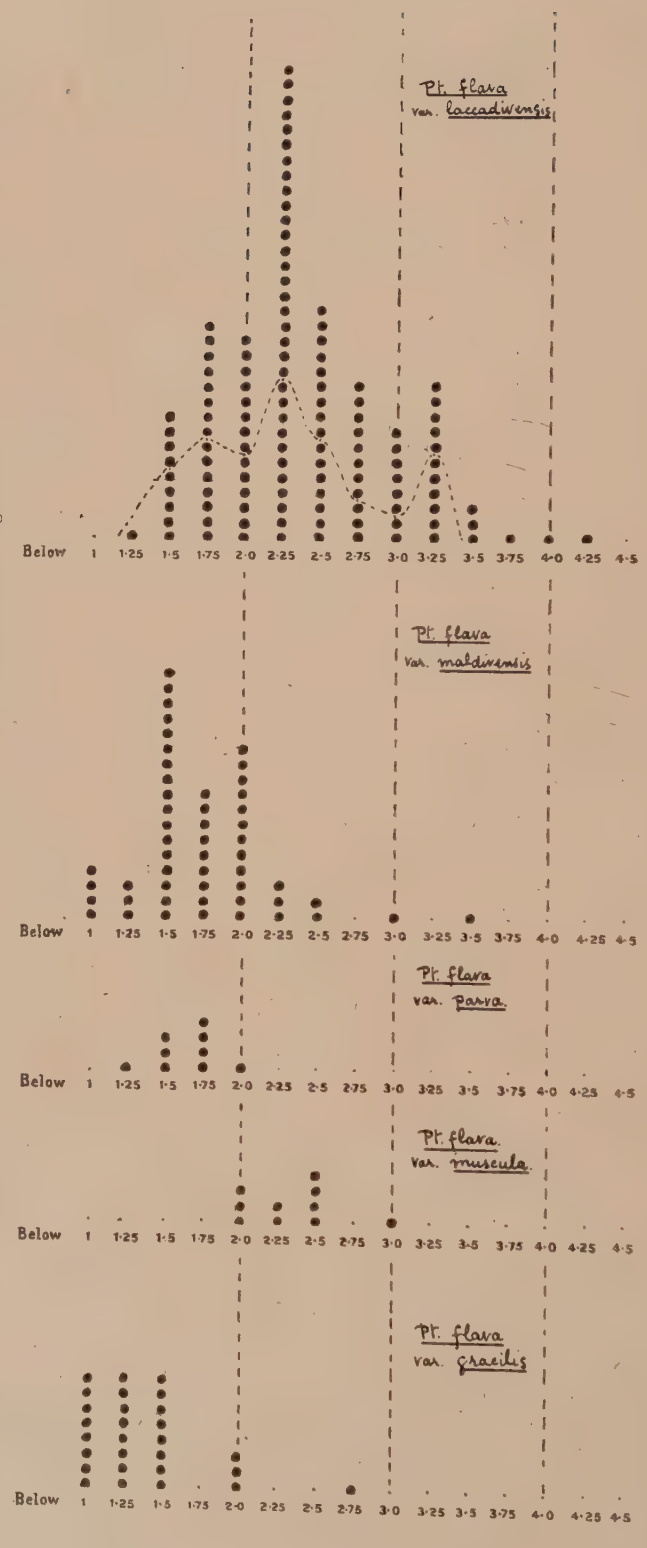

FIG. 121. This figure illustrates graphically the variations in the ratio $\frac{\text{Branchial length}}{\text{Collar length}}$ which occur in the different varieties of *Pt. flava*. Each dot signifies a single specimen. Thus in the material of *Pt. flava*, var. *maldivensis*, there are two specimens in which the branchial length is 2·25—2·49 times the length of the collar in those specimens. The unit of variation selected is $\frac{1}{4}$ × collar length in each case. The dots below the dotted line in the figure for *laccadivensis* are all specimens belonging to Group 1 (see p. 663), and the distribution of these in the diagram illustrates graphically the fact that this ratio is independent of growth at these stages.

In fact from these figures one may affirm with some confidence that *laccadivensis* and *muscula* (though they cannot be separated from one another by this criterion) are quite separate from *maldivensis*, *gracilis*, and *parva*, whilst of the last three *gracilis* is very probably distinct from the other two. By this criterion alone it is not possible to separate *maldivensis* from *parva* any more than *laccadivensis* from *muscula*. No doubt this could be done in the case of these forms if the material were sufficient to treat another ratio (*e.g.* the length ratio) in the same way.

The total length ratio was worked out for *laccadivensis* and *maldivensis*, in which forms alone the amount of material rendered the attempt feasible. As there are no definite segments by which to reckon, the absolute value obtained for σ will depend upon the number of groups into which the material is broken up. In this case the mean in the two varieties is 23·1 and 17·9 respectively. The series have been broken up into groups separated by an interval of two units, which is approximately 10 °/₀ of the mean in each case. The treatment has been uniform in each case and the results are as follows:—

TABLE 9.

	var. *laccadivensis*	var. *maldivensis*
M. =	23·1	17·9
P.E.M. =	± ·129	± ·260
σ =	±1·798	±1·589
P.E. σ =	± ·091	± ·184
N. =	49	17

Hence the mean is widely separate in the two forms—separated by so many times the probable error as to render it absolutely certain that no random selection of 17 specimens from a large quantity of *laccadivensis* could ever have a mean length ratio with the remotest approximation to the above 17 specimens of *maldivensis*.

Leaving now the question of variation as a criterion of species and variety we may pass on to consider one other point in connection with it. A great feature in the group of the segmented Chordata is the process of cephalization which becomes more and more pronounced as we pass upwards from *Amphioxus* to Mammals. Accompanying this process, and doubtless intimately bound up with it, is the phenomenon of unequal variability in the different regions of the animal's body from the meristic point of view. With increased cephalization we find associated a decreased variability at the cephalic as compared with the caudal end. The nearer we approach to the caudal extremity the greater appears to become the meristic variability[1]. From this point of view the relative variability of the different regions of the Enteropneust's body becomes of interest, especially as most writers see in the collar cord the commencement of the cephalization process. From the data given in Table 11, p. 671,

[1] For the present this statement is based upon a number of unpublished data from different Vertebrata, chiefly fishes, collected by the writer. The phenomenon is perhaps most familiar in the case of the Mammals where, speaking generally, the cervical region exhibits no meristic variation, the dorso-lumbar and sacral regions a small amount, whilst the caudal region exhibits most of all. Probably some such phenomenon is to be found also among Invertebrates, but absence of data permits only of conjecture.

I have therefore estimated the variability of three separate regions of the body in *Pt. laccadivensis*, viz. the branchial region, the genito-hepatic region, reaching from the hind end of the branchial region to the point of junction of light and dark hepatic caeca, and the hepatic-caudal, extending from this point of junction to the anus. In the following table this is expressed quantitatively when the unit of variation[1] selected was the same in all three cases, *i.e.* collar length × 1.

TABLE 10.

	σ	C.V. $= \frac{\sigma \times 100}{M.}$
Branchial region	± ·6712	29·66
Genito-hepatic region ...	±1·015	20·72
Hepatic-caudal region ...	±2·711	11·79

From this table it appears that the variability as measured by the standard deviation gradually rises as we recede from the collar. But these three regions are of very different length and the unit of measurement (collar length) bears towards the branchial region a relation as regards length very different to that which it bears towards the hepatic-caudal region. To avoid this difficulty we must consider the coefficient of variation (C.V.) in each case, and when this is worked out (Table 10) it is at once evident that the relative variability of the branchial region as regards length is far greater than that of the genito-hepatic, and this again than that of the hepatic-caudal. In a word, as we proceed caudalwards from the collar the relative variability of the body as regards length becomes less. In *Amphioxus* and the Vertebrata on the other hand the relative variability of the body as measured by the number of segments becomes greater as we proceed caudalwards. One of three alternatives would seem to follow:—either (1) we must regard the processes of differential growth as widely different in the two cases, or (2) we must look upon the number of a meristic series as altogether independent of its length, or (3) we must consider that there exists in *Ptychodera* a somewhat vague segmentation—that the animal is composed of morphologically equivalent though ill-defined segments of which the length differs considerably in different regions of the body. The amount of favour with which we can regard the first of these suggestions depends upon our conception of the relations of the Enteropneusts to the Chordata. Those who are inclined to uphold the chordate affinities of this group would naturally turn to either of the other two alternatives. The former of these I regard as untenable, since such data as I have been able to collect on the subject all tend to shew that there is a fairly high correlation between the relative total length of a vertebrate axial meristic series and the number of units of which it is composed. There remains to be considered the last of these hypotheses. Are there grounds for attributing any form of segmentation[2] to the Enteropneustic body, and further, if this is the case, for considering that such segments may differ in size in the different regions of the animal? To the first part of the question the answer must be in the affirmative. In the branchiae, in the hepatic caeca, and in the epidermal annulations, we have series of repeated parts of which the latter two

[1] The choice of the unit is often a matter of convenience. Thus in Text-fig. 121, p. 666, the unit of variation selected is collar length × ½.

[2] Apart of course from the primitive segmentation into the three regions, proboscis, collar, and trunk.

usually correspond fairly closely (cf. Willey, **'99,** Pl. XXVI. fig. 1, and Spengel, **'03,** Pl. XXIV. fig. 8). With regard to the second part of the question it may be easily demonstrated that in a given stretch of body length the branchiae are more numerous than are the epidermal annulations or the hepatic caeca in a stretch of the same length in the post-branchial region. The number of tongue bars averages about 5·6 per mm. of length (see Table 14, p. 675). On the other hand the number of epidermal annulations in the post-hepatic region is about 1·6 per mm. Therefore if we look upon these repeated parts as evidences of a rudimentary segmentation[1], we must regard the post-branchial segments (or at least those of the hepatic caudal region) as being on the average 3·5 times as long as the branchial segments. In other words the branchial segments are three times as numerous as the hepatic-caudal ones per unit of length. Consequently if we calculate the coefficients of variation on the basis of "segments" instead of collar length units we must multiply the coefficient of variation for hepatic-caudal region by 3·5 in order to compare it directly with that for the branchial region. This brings it up to the value 41·26 as compared with 29·66 for the branchial region. If therefore we regard the Enteropneusts as exhibiting a rudimentary form of segmentation the variability in the different body regions falls into line with that of the Holochorda[2]. Much phylogenetic stress however must not be laid upon this point since it is not improbable that the phenomenon of cephalization may be shewn to be widespread among the Invertebrates also. What is of more importance is the influence, small though it be, which the occurrence in the Enteropneusta of a form of segmentation, similar in kind though less marked, may exert upon our conception of the manner in which the merism of the Vertebrata may have arisen. And here a few remarks of a more speculative nature may not be irrelevant in connection with

METAMERISM IN THE ENTEROPNEUSTA.

Willey (**'99,** p. 303) has recently made a brilliant suggestion with regard to the origin of gill clefts. The discovery of the peculiar dermal pits of *Spengelia* has led him to regard gill-slits as having originally arisen as perforations in the interannular grooves formed for the aeration of the gonads, a function which they eventually gave up for that of respiration on the establishment of an elaborate vascular system. In this way Willey establishes a connection between the segmentation of the gills and of the epidermal annulations, the connecting link being the gonads. It has seemed to me possible to extend this conception of Willey's and to see in the gonads and their arrangement the prime factor in the segmentation of the chordata. We may take as our starting-point a small Triploblastic (and perhaps also Tricoelomate) creature with three more or less definite body regions, of not widely unequal length, and of which the hindermost contains the gonads. The reproductive elements would be small and fertilization external in the sea. Under these conditions it is obvious that, other things being equal, those with the largest gonads would have the best chance of leaving offspring to perpetuate and amplify this feature. Increased size of

[1] Spengel (**'03,** p. 276 seq.) disagrees with Willey's view of the significance of the epidermal annulations and sees in them only the effects of muscular contraction on the disposition of the epidermal glands. He points out that there exists a certain amount of irregularity. Such irregularity however seems to me in no way to militate against the view of the significance of these structures taken by Willey.

[2] It is interesting to notice that in *Ptychodera* the difference between variability in the different regions of the body is not nearly so marked as in *Amphioxus* where we may regard the cephalization process as having extended further. I have found the following values for C.V. in different regions of the latter genus. Preatrioporal segments, C.V. = 1·792; postatrioporal preanal, C.V. = 2·655; postanal, C.V. = 6·185.

gonad spells increased bulk and in the absence of a specialized vascular system this increase of bulk must be almost entirely dependent on increased length. For respiration would depend on transepidermal diffusion, a process which would more readily occur in a long slender animal than in a short thick one. This great elongation of the gonad would necessitate the establishment of accessory ducts by which its products could readily and rapidly escape. From this it is but a short step to the stage of a series of independent gonads each with its own duct extending throughout the elongated trunk region—a condition physiologically comparable to that now found among the Nemerteans. Increase of bulk will still mean increased fertility and such individuals will be favoured by Genetic Selection[1], provided always that the means for ensuring due aeration are adequate, whence we come to the establishment of dermal pits for the aeration of the gonads. Later the pits become perforated and no doubt these perforations supplied a physiological need and filtered off the excess of water from the sand passing through the animal's alimentary canal. Probably it was somewhere near this phylogenetic epoch that the ancestral Enteropneusts took to an arenicolous life. The problem of extraction of nutriment from a relatively enormous mass of innutritious substance resulted in the specialization of the middle and hinder part of the digestive tract, and the establishment of the hepatic caeca led to the disappearance of the gonads in this region. They have left traces of their former presence in the epidermal annulations which shew some tendency to irregularity now that their determining cause has disappeared; they are still found in a rudimentary state in the hepatic region of some forms, but increased physiological specialization has on the whole led to their confinement to the more anterior portions of the trunk.

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[1] Cf. Pearson, K., *The Grammar of Science*, 1900, p. 437, and also *The Chances of Death, etc.*, 1897, Vol. i. p. 63 (Essay on Reproductive Selection).

Table 11.

Pt. flava, var. *laccadivensis*.

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)			No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total		Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	4	4	—	1·50	—	—	32	3·5	3	—	2·28	4·85	—
2	4	4	80	2·12	4·13	20·0	33	3·5	3·5	—	1·28	2·07	—
3	4	4	—	2·00	6·75	—	34	3	3·5	74	2·50	3·83	24·6
4	3·5	3·5	82	1·71	5·14	23·5	35	4	4	114	2·00	7·75	28·5
5	3·5	3·5	75	2·14	5·00	21·4	36	3	3·5	78	1·33	4·50	26·0
6	4	4	78	1·75	4·75	19·5	37	4	4	—	2·25	4·75	—
7	3·5	3·5	—	2·00	6·00	—	38	4	4	76	1·37	4·37	19·0
8	3	3	—	3·00	—	—	39	3·5	4	73	1·14	5·28	20·8
9	4	4	—	1·25	5·50	—	40	3	3·5	76	3·00	4·66	25·3
10	3	2·5	60	1·83	4·17	20·0	41	3·5	3·5	83	2·14	4·71	23·7
11	3·5	3·5	90	2·71	6·43	25·7	42	4	4	—	2·12	5·62	—
12	4	3·5	—	1·75	—	—	43	3·5	4	—	2·00	5·85	—
13	4	4	—	3·00	—	—	44	4	4	—	2·37	5·37	—
14	3·5	3·5	105	1·75	4·43	30·0	45	3·5	4	—	2·85	5·14	—
15	4	4	—	2·75	5·50	—	46	3	3·5	—	1·63	4·16	—
16	4	4	—	3·00	—	—	47	3	3	—	1·63	4·16	—
17	4	4	—	1·50	—	—	48	5	5	120	2·80	—	24·0
18	3	3	—	3·00	4·66	—	49	5	5	110	2·30	—	22·0
19	3	3	—	2·33	6·33	—	50	5	5	—	2·80	—	—
20	2·5	2·5	60	1·80	4·20	24·0	51	5	5	—	2·00	—	—
21	3	3	—	2·00	6·00	—	52	5	5	93	2·60	4·20	18·6
22	3	3	—	2·00	—	—	53	5	5	—	2·00	—	—
23	3·5	3·5	74	1·85	5·27	21·1	54	5	5	—	2·20	—	—
24	3·5	3·5	—	2·43	—	—	55	5	5	140	2·70	3·50	28·0
25	4	4	—	3·00	—	—	56	5	5	125	2·50	5·10	25·0
26	3	3	—	2·66	4·67	—	57	5	5	125	2·20	5·40	25·0
27	3	3	—	2·00	4·66	—	58	5	5	—	1·50	6·50	—
28	4	4	85	1·37	4·37	21·2	59	4·5	4·5	—	3·33	—	—
29	3·5	3·5	74	2·28	4·85	21·1	60	5	5	—	2·10	4·30	—
30	4	4	93	2·25	3·50	23·2	61	5	5	111	1·90	6·10	22·2
31	4	3·5	—	1·75	4·37	—	62	5	5	105	2·20	3·80	21·0

Nos. 1—47 (inclusive) = Group 1.
„ 48—92 „ = Group 2.
Nos. 93—119 (inclusive) = Group 3.
„ 120—123 „ = Group 4.

In Group 1 Collar length × breadth is not greater than 16.
„ „ 2 „ „ × „ is greater than 16, but not greater than 25.
„ „ 3 „ „ × „ is „ „ 25, „ „ „ 36.
„ „ 4 „ „ × „ is „ „ 36.

TABLE 11 (*continued*).

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)			No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total		Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
63	4·5	4·5	96	2·11	4·77	21·3	94	6	6	150	3·50	—	25·0
64	5	5	100	1·80	4·80	20·0	95	5	6	112	2·60	—	22·4
65	5	5	—	3·00	2·22	—	96	6	5	—	2·08	—	—
66	5	5	—	2·20	4·40	—	97	6	6	—	2·16	—	—
67	4·5	4·5	—	2·44	—	—	98	5	6	—	2·20	—	—
68	4·5	5	110	1·66	5·89	24·4	99	6	6	—	3·00	—	—
69	5	5	115	2·60	7·00	23·0	100	6	6	—	2·00	4·33	—
70	5	5	—	3·00	4·60	—	101	5	6	—	3·40	—	—
71	5	4·5	—	1·50	6·90	—	102	6	5	—	2·00	—	—
72	5	5	—	2·00	—	—	103	6	5	—	2·83	—	—
73	5	4·5	108	2·00	4·60	21·6	104	5·5	5·5	—	2·55	—	—
74	5	5	105	2·00	5·60	21·0	105	6	6	—	2·00	5·33	—
75	5	5	—	2·00	3·00	—	106	6	5	—	1·66	—	—
76	4·5	4·5	—	1·77	6·00	—	107	5	6	85	1·60	2·60	17·0
77	5	5	—	1·80	4·60	—	108	5	6	100	2·20	5·40	20·0
78	5	5	—	2·40	—	—	109	5	5·5	130	2·40	6·00	26·0
79	4·5	4	—	1·25	5·75	—	110	5	6	109	2·40	4·40	21·8
80	4·5	4·5	—	1·44	—	—	111	5	6	—	1·70	4·30	—
81	5	4	—	1·80	—	—	112	5	5·5	136	2·80	4·80	27·2
82	5	4·5	—	2·75	5·20	—	113	6	6	140	1·91	4·75	23·3
83	5	5	—	2·90	3·40	—	114	5	5·5	116	1·70	5·50	23·2
84	4	5·5	76	1·37	5·12	19·0	115	5	5·5	123	2·50	4·70	24·6
85	5	4·5	—	1·50	4·10	—	116	6	5·5	138	1·50	5·33	23·0
86	5	4·5	—	1·40	4·20	—	117	6	5·5	—	1·75	4·25	—
87	5	4	102	1·80	4·40	20·4	118	5	5·5	116	2·50	4·90	23·3
88	4	4·5	98	2·25	4·75	24·5	119	5	5·5	—	3·00	6·00	—
89	5	5	—	3·80	6·40	—	120	7	7·5	140	2·28	3·71	20·0
90	5	5	—	2·00	5·80	—	121	6·5	7	—	3·39	—	—
91	5	5	—	2·10	5·50	—	122	6	7	145	3·16	—	24·1
92	5	5	—	2·40	3·80	—	123	7	7	—	2·28	—	—
93	6	6	—	4·00	—	—							

TABLE 12.

Pt. flava, var. *muscula*.

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	2·5	3	31	2·20	1·20	12·4
2	3	4	48	2·33	3·66	16·0
3	2	2·5	37	2·50	2·75	18·5
4	2·5	3	35	2·20	3·40	14·0
5	2·5	3	43	2·80	1·60	17·2
6	3	3·5	—	2·00	2·00	—
7	3	3·5	—	2·00	3·33	—
8	3	3	—	2·50	1·83	—
9	2·5	3·5	—	2·40	3·80	—
10	2·5	3	—	2·00	1·80	—

Pt. flava, var. *parva*.

Relative length of branchial region (collar length = 1) in 9 Specimens =
1·20, 1·33, 1·33, 1·40, 1·60, 1·60, 1·60, 1·66, 2·00.

Collar length in each case was 2·5—3 mm.

In one complete Specimen total length = 30 mm. and relative length (collar length = 1) was 12·0.

Pt. flava, var. *gracilis*.

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	3	3	65	1·66	—	21·6
2	2	2·5	68	2·00	—	34·0
3	2	2	36	1·25	—	18·0
4	2	2·5	56	2·00	—	28·0
5	3	3	—	1·83	—	—
6	2·5	2·5	—	1·40	—	—
7	3	3	—	1·33	—	—
8	2	2	—	1·50	—	—
9	2	2	—	1·25	—	—
10	1·5	1·5	41	1·33	—	27·3
11	2·5	3	—	1·40	—	—
12	2·5	2·5	49	1·20	—	19·6
13	2	2·5	—	1·50	—	—
14	2·5	2·5	40	1·20	—	16·0
15	2	2	36	1·00	—	18·0
16	2	2·5	44	1·50	—	22·0
17	2·5	3	44	1·20	—	17·6
18	2·5	3	—	1·40	—	—
19	2·5	3	—	1·20	—	—
20	2·5	2·5	42	1·00	—	16·8
21	2·5	2·5	36	1·20	—	14·4
22	2·5	2·5	42	1·00	—	16·8
23	3	2·5	44	1·00	—	14·6
24	2	2·5	—	1·25	—	—
25	2·5	2·5	40	1·00	—	16·0
26	2	2	32	1·00	—	16·0
27	2	2	34	1·00	—	17·0
28	2	2	—	1·00	—	—

TABLE 13.

Pt. flava, var. *maldivensis*.

No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)			No. of Specimen	Absolute measurements (in millimetres)			Relative measurements (collar length = 1)		
	Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total		Collar length	Collar breadth	Total length	Branchial	Genito-hepatic	Total
1	2·5	3	—	1·40	3·60	—	27	4	4	—	1·75	3·75	—
2	2·5	3	—	2·00	5·00	—	28	3	3	—	1·50	3·83	—
3	2·5	3	—	2·20	5·20	—	29	3	3	—	1·50	4·50	—
4	3	2·5	48	1·00	4·66	16·0	30	3	3	65	1·83	7·16	21·6
5	2·5	3	—	1·40	3·40	—	31	3·5	3	68	1·57	3·42	19·4
6	2·5	3	—	1·60	6·20	—	32	3	3·5	50	1·50	3·50	16·6
7	2·5	3	48	1·40	4·60	19·2	33	3·5	3·5	62	1·42	6·28	19·0
8	2·5	2·5	43	2·00	3·80	17·2	34	3	3·5	64	2·50	4·33	21·3
9	2·5	3	—	1·80	6·80	—	35	3·5	3	—	1·14	3·85	—
10	2·5	3	—	2·40	5·40	—	36	3	3	—	1·00	4·33	—
11	2·5	3	—	1·80	4·40	—	37	3	3	—	1·00	3·33	—
12	2·5	3	—	1·40	4·25	—	38	3	3	—	1·66	3·00	—
13	2·5	3	—	2·00	4·60	—	39	3	3	—	1·66	3·00	—
14	2·5	2·5	41	1·80	4·60	16·4	40	3	3	38	1·16	3·33	12·6
15	2·5	3	39	1·40	3·80	15·6	41	3·5	4	—	1·71	5·85	—
16	3	2·5	—	1·33	3·66	—	42	3	3	—	1·50	4·16	—
17	2	2·5	29	1·00	2·75	14·5	43	3	3	—	1·33	4·00	—
18	2·5	3	—	1·60	5·00	—	44	3	3	41	1·16	3·83	13·6
19	2·5	3	—	1·80	5·40	—	45	3	3	—	2·00	6·50	—
20	3·5	3·5	—	1·57	3·00	—	46	3	3	—	1·50	4·83	—
21	3	3·5	72	3·00	5·00	24·0	47	3	3	—	1·83	4·16	—
22	4	4	—	1·37	3·12	—	48	4·5	4	—	1·55	4·55	—
23	3	3	—	1·33	2·33	—	49	4	4·5	—	3·50	6·25	—
24	4	4	80	1·87	4·12	20·0	50	4	4·5	68	1·37	4·50	16·5
25	3	3	—	2·16	4·16	—	51	4	4·5	75	1·37	5·50	18·7
26	3	3	—	2·00	3·33	—	52	4	4·5	—	2·25	5·37	—

Nos. 1—19 (inclusive)=Group 1. Nos. 20—47 (inclusive)=Group 2. Nos. 48—52 (inclusive)=Group 3.

In Group 1 Collar length × breadth is less than 9.
" " 2 " " × " is not less than 9, or greater than 16.
" " 3 " " × " is greater than 16.

TABLE 14.

Pt. flava, var. *laccadivensis*.

	No. of tongue bars	Length in mm.	Tongue bars per mm.	No. of tongue bars	Length in mm.	Tongue bars per mm.
	104	19	5·4	55	9·5	5·8
	98	18	5·4	52	10	5·2
	83	14	5·9	50	9·5	5·3
	79	14	5·6	50	9·5	5·3
	74	15	4·9	49	8	6·1
	71	13·5	5·3	48	9	5·3
	70	14·5	4·8	48	7·5	6·4
	66	13	5·1	47	8	5·9
	64	10	6·4	40	7	5·7
	62	12	5·2	40	7	5·7
	62	11	5·6	38	6	6·3
	59	10	5·9	34	5·5	6·2
	57	10	5·7	32	5·5	5·8
	56	10	5·6	30	4·5	6·6
Average	71·8	13·1	5·5	43·8	7·6	5·8

EXPLANATION OF PLATES.

adv. = advehent vessel of proboscis.
anp. = anterior neuropore.
bm. = basement membrane.
bp. = branchial pouch.
bv. = blood vessel.
c. = collar coelom.
cc. = collar canal.
ch. = chondroid tissue.
cl. = central lumen of stomochord.
cn. = cornua of nuchal skeleton.
cnu. = nuchal collar coelom (containing muscles).
ct. = connective tissue.
cvr. = vascular ring of collar.
dn. = dorsal nerve.
dpc. = dorsal proboscis coelom.
ds. = dorsal septum.
dv. = dorsal vessel.
el. = external longitudinal muscles of collar.
ev. = efferent proboscis vessel.
g. = gonad.
gc. = ganglion cells.
gcd. = dorsal ganglion cells of collar cord.
gcv. = ventral ganglion cells of collar cord.
gl. = gland cells.
glo. = glomerulus.
gp. 1. = 1st gill pouch diverticulum.
il. = internal longitudinal muscles of collar.
int. = intestine.
ldc. = left diverticulum of dorsal proboscis coelom.
ll. = lateral lumen of stomochord.
lm. = longitudinal muscles.
ls. = lateral septum.
lu. = lumen of collar cord.
mc. = circular muscles.
mdv. = dorso-ventral muscles.
ml. = longitudinal muscles.
mlc. = longitudinal muscles of collar.
mld. = longitudinal dorsal muscles.
mll. = longitudinal lateral muscles.
mlv. = longitudinal ventral muscles.
n. = nuchal skeleton.
ngl. = gland cells of collar cord.

nk. = keel of nuchal skeleton.
nl. = layer of nerve fibrils (Punkt-substanz).
o. = oesophagus.
oep. = oesophageal epithelium.
on. = oesophageal nerve.
p. = proboscis coelomic cavity.
pb. = parabranchial ridge.
pbg. = post-branchial groove.
per. = pericardium.
ph. = perihaemal space.
pg. = pygochord.
pig. = pigment.
pnp. = posterior neuropore.
pp. = proboscis pore.
pph. = peripharyngeal space.
pvl. = left proboscis end vesicle.
pvr. = right proboscis end vesicle.
r. = either (1) racemose organ or (2) dorsal root.
rdc. = right diverticulum of dorsal proboscis coelom.
s. = stomochord.
sc., *sld.* = cavity of lateral diverticulum of stomochord.
sk. 1. = nuchal skeleton.
skg. = branchial skeleton.
tb. = tongue bar.
v. = vermiform process of stomochord.
vn. = ventral nerve.
vpc. = ventral proboscis coelom.
vrv. = ventral recurrent vessel of proboscis.
vs. = ventral septum.
vv. = ventral vessel.

PLATE XXXVII.

FIG. 1. *Ptychodera asymmetrica.* × 3.

FIG. 2. *Pt. viridis*, ventral view. Slightly enlarged.

FIG. 3. *Balanoglossus carnosus.* Slightly reduced.

FIG. 4. *Pt. flava*, var. *gracilis.* × 2.

FIG. 5. *Pt. flava* (var. *maldivensis*?). Regenerating. × 1.

FIG. 6. *Pt. viridis*, dorsal view. Slightly enlarged.

FIG. 7. *Pt. viridis*, lateral view. Slightly enlarged.

FIG. 8. *Pt. flava* (var. *maldivensis*?). Regenerating. × 1.

FIG. 9. *Pt. asymmetrica.* A large specimen. Slightly enlarged.

PLATE XXXVIII.

FIG. 10. *Ptychodera flava*, var. *gracilis.* Preserved specimen from Hulule. × $\frac{5}{2}$.

FIG. 11. *Pt. flava*, var. *parva.* From preserved specimen. × 3.

FIG. 12. *Pt. flava*, var. *cooperi.* From preserved specimen. A small portion of the caudal end probably missing. × 5.

FIG. 13. *Spengelia porosa.* A small portion of the hepatic region. × 4.

FIG. 14. *Willeyia bisulcata.* Anterior end seen from dorsal surface. × 3.

FIG. 15. *Balanoglossus parvulus.* Section through the collar cord. A small clot of mucous substance is seen in the lumen. × 85.

FIG. 16. *Pt. flava*, var. *parva.* Section through anterior collar region with the 1st dorsal root coming off the collar cord. × 20.

FIG. 17. *Pt. flava*, var. *saxicola*. Dorsal view, slightly enlarged.

FIG. 18. *Balanoglossus parvulus*. Anterior end from dorsal surface. × 6.

FIG. 19. *Pt. flava*, var. *gracilis*. Preserved specimen from Minikoi. × 3.

FIG. 20. *Pt. flava*, var. *parva*. Section through collar cord. The dorsal and ventral walls of the central lumen shew a tendency to stick together. × 85.

FIG. 21. *Pt. flava*, var. *parva*. Section similar to above but from another specimen. The central lumen shews a marked tendency to occlusion and the lateral gland cells (*gl.*) are strongly developed. × 85.

FIG. 22. *Balanoglossus parvulus*. Section through proboscis pore. × 45.

FIG. 23. *Willeyia bisulcata*. Section through collar cord. × 85.

PLATE XXXIX.

FIG. 24. *Balanoglossus parvulus*. Section through collar. × 45.

FIG. 25. *Pt. flava*, var. *laccadivensis*. Section through proboscis. × 45.

FIG. 26. *Pt. flava*, var. *parva*. Section through anterior collar region. × 20.

FIG. 27. *Pt. flava*, var. *maldivensis*. Section through edge of left genital pleura. × 85.

FIG. 28. *Pt. flava*, var. *saxicola*. Unusual dorsal root formed by pigmented outgrowth from collar cord and glandular ingrowth from epidermis. These two portions fuse a few sections further back. × 85.

FIG. 29. *Willeyia bisulcata*. Section through proboscis towards its hinder end. The dorso-ventral muscles (*mdv.*) are seen converging to the minute vermiform process of the stomochord. × 45.

FIG. 30. *Pt. flava*, var. *saxicola*. Small portion of inner surface of genital pleura shewing ingrowth from epidermis forming gonad. × 110.

FIG. 31. *Pt. flava*, var. *saxicola*. Section through tip of a genital pleura shewing epidermal ingrowth forming gonad. × 180.

FIG. 32. *Pt. viridis*. Section through proboscis. × 20.

PLATE XL.

FIG. 33. *Pt. flava*, var. *parva*. An immature gonad shewing ectodermal connection, and quantity of mucus inside. × 180.

FIG. 34. *Spengelia maldivensis*. Section through collar canal just anterior to its opening into the first gill pouch. Ventral to it is the blind diverticulum of the first gill pouch of which the internal opening is marked by an asterisk *. × 85.

FIG. 35. *Pt. flava*, var. *parva*. An immature gonad in which the ectodermal connection is occluded by a mucous plug. × 180.

FIG. 36. *Pt. flava*, var. *laccadivensis*. From young specimen (anterior hepatic region) shewing very young gonad connected with the ectoderm. × 410.

Fig. 37. *Pt. flava*, var. *muscula*. A nearly ripe ♂ gonad breaking through to the ectoderm. × 180. (*sp* = spermatocytes.) From an iron haematoxylin preparation.

Fig. 38. *Pt. flava*, var. *laccadivensis*. From young specimen. *a*—*e* represent stages in the formation of the giant nutritive cells. All × 520.

Fig. 39. *Pt. flava*, var. *laccadivensis*. Young gonad, shewing cavity formed inside, and outer coat of nutritive cells forming a kind of follicle. The membrane surrounding the gonad derived from the lateral septum is still intact. × 410.

Fig. 40. *Pt. flava*, var. *laccadivensis*. Young gonad, slightly older than in preceding figure. The membrane surrounding the gonad tends to break down in places. × 410.

Fig. 41. *Pt. flava*, var. *saxicola*. Section through young gonad with ectodermal connection. At the base of the gonad the membrane is deficient permitting the invasion of nutritive cells. × 180.

Fig. 42. *Pt. flava*, var. *saxicola*. Gonads somewhat older than in preceding figure. × 110.

PLATE XLI.

Fig. 1. *Balanoglossus parvulus*. Section through branchial region. × 45.

Fig. 2. *B. parvulus*. Through region of post-branchial groove. × 45.

Fig. 3. *B. parvulus*. Through nuchal skeleton in anterior region of collar. × 45.

Fig. 4. *B. parvulus*. Through post-branchial genital region. × 45.

Fig. 5. *Spengelia porosa*. Through hepatic region. On the right the section has gone through the middle of a hepatic caecum. × 12.

Fig. 6. *Sp. maldivensis*. Section through nuchal skeleton in the region of the keel (*nk.*). The perihaemal cavity (*ph.*) of the right side is seen at this level. That of the left side does not reach so far forwards. × 45.

Fig. 7. *Sp. porosa*. Section through the intestinal region behind the hepatic caeca. × 12.

Fig. 8. *Sp. maldivensis*. Schematic longitudinal sagittal section reconstructed from transverse sections. × 10.

Fig. 9. *Willeyia bisulcata*. Section through proboscis pore. × 45.

Fig. 10. *W. bisulcata*. Schematic reconstruction as in fig. 8. × 10.

PLATE XLII.

Fig. 11. *Spengelia porosa*. Section through posterior part of proboscis. × 12.

Fig. 12. *Willeyia bisulcata*. Section through anterior part of proboscis. × 30.

Fig. 13. *W. bisulcata*. Section through branchial region. × 22.

Fig. 14. *W. bisulcata*. Section through genital region. × 22.

Fig. 15. *W. bisulcata*. Section through hinder part of anterior neuropore. × 45.

Fig. 16. *W. bisulcata*. Through anterior part of anterior neuropore, shewing the œsophageal nerve coming off on the left side of the figure. × 45.

FIG. 17. *Ptychodera viridis.* Section through post-branchial groove. × 12.

FIG. 18. *Pt. flava*, var. *muscula.* Section just anterior to the proboscis pores, shewing the expansion of the nuchal skeleton over the racemose organ (*r*). × 45.

FIG. 19. *Pt. viridis.* Section through anterior collar region. × 20.

FIG. 20. *Sp. maldivensis.* Section through post-branchial groove. × 45.

PLATE XLIII.

All figures on this plate are from *Pt. flava*, var. *parva.*

FIG. 21. Through anterior part of proboscis. × 30.

FIG. 22. Through anterior portion of central proboscis complex. × 30.

FIG. 23. Through specimen in which the two proboscis pores have a common opening near the mid-dorsal line. × 54.

FIG. 24. Through hinder part of proboscis shortly before the lateral diverticula of the stomochord appear. × 54.

FIG. 25. Through region of the lateral diverticula of the stomochord. × 54.

FIG. 26. Through the proboscis pores behind the lateral diverticula of the stomochord. × 54.

FIG. 27. Through anterior cavity containing region of collar. × 30.

FIG. 28. Through region of racemose organ, behind the proboscis pores. × 54.

PLATE XLIV.

FIG. 29. *Pt. flava*, var. *asymmetrica.* Section through collar cord. × 45.

FIG. 30. *Pt. flava*, var. *parva.* Section through same level as Pl. XLIII. fig. 25, but through another specimen in which the lumen of the stomochord is obliterated instead of being patent. × 45.

FIG. 31. *Pt. flava*, var. *parva.* Section through middle of collar region shewing longitudinal muscles arranged in bundles. × 20.

FIG. 32. *Pt. flava*, var. *parva.* Section through proboscis pores. In this specimen the perihaemal spaces reach forwards to this level. More usually they commence shortly behind the pores (cf. Pl. XLIII. figs. 23, 26). × 45.

FIG. 33. *Pt. flava*, var. *saxicola.* Section just anterior to the proboscis pores shewing great width of keel of nuchal skeleton. × 45.

FIG. 34. *Pt. flava*, var. *saxicola.* Section through stomochord in region of lateral diverticula. × 85.

FIGS. 35, 36, 37. *Pt. flava*, var. *saxicola.* Sections through the pygochord. The three sections are from the same specimen; fig. 35 is nearest to the anus, fig. 37 is furthest from it. × 85.

FIG. 38. *Pt. flava*, var. *saxicola.* Through anterior branchial region. × 12.

FIG. 39. *Pt. flava*, var. *saxicola.* Through posterior branchial region of same specimen as in fig. 38. × 12.

FIG. 40. *Pt. flava*, var. *saxicola.* Through level immediately behind the post-branchial groove. Also from same specimen as fig. 38. × 12.

FIG. 41. *Pt. flava*, var. *saxicola.* Through region of post-branchial groove. The genital pleurae are still almost as large as in the branchial region. × 12.

PLATE XLV.

Fig. 42. *Pt. flava*, var. *gracilis*. Section through hinder part of collar region. × 45.

Fig. 43. *Pt. flava*, var. *laccadivensis*. Sections through stomochord. All × 85.

a. Near anterior extremity.

b. At anterior level of lateral diverticula.

c. Through lateral diverticula at their maximum breadth.

d. In region of nuchal skeleton.

Fig. 44. *Pt. flava*, var. *gracilis*. Through stomochord, shewing completely obliterated lumen. × 85.

Fig. 45. *Pt. flava*, var. *cooperi*. Through keel of nuchal skeleton. × 85.

Fig. 46. *Pt. flava*, var. *cooperi*. Through proboscis stalk close to opening of proboscis pores. × 85.

Fig. 47. *Pt. flava*, var. *cooperi*. Through post-branchial groove. The groove is large and the genital pleurae well marked. × 45.

PLATE XLVI.

Sections through the region of the branchial and post-branchial groove in several species and varieties of *Ptychodera*. All × 27.

Fig. 48. *Pt. flava*, var. *parva*. Through middle of branchial region.

Fig. 49. *Pt. flava*, var. *laccadivensis*. Through post-branchial groove.

Fig. 50. *Pt. flava*, var. *gracilis* (Hulule). Through middle of branchial region.

Fig. 51. *Pt. flava*, var. *laccadivensis*. Through hind end of post-branchial groove.

Fig. 52. *Pt. asymmetrica*. Through middle of branchial region.

Fig. 53. *Pt. flava*, var. *gracilis* (Hulule). Through hind end of post-branchial groove.

Fig. 54. *Pt. flava*, var. *gracilis* (Minikoi). Through branchial region.

Fig. 55. *Pt. flava*, var. *gracilis* (Minikoi). Through hind end of post-branchial groove.

Fig. 56. *Pt. asymmetrica*. Through posterior branchial region.

Fig. 57. *Pt. flava*, var. *laccadivensis*. Through middle of branchial region.

Fig. 58. *Pt. asymmetrica*. Through hind end of post-branchial groove.

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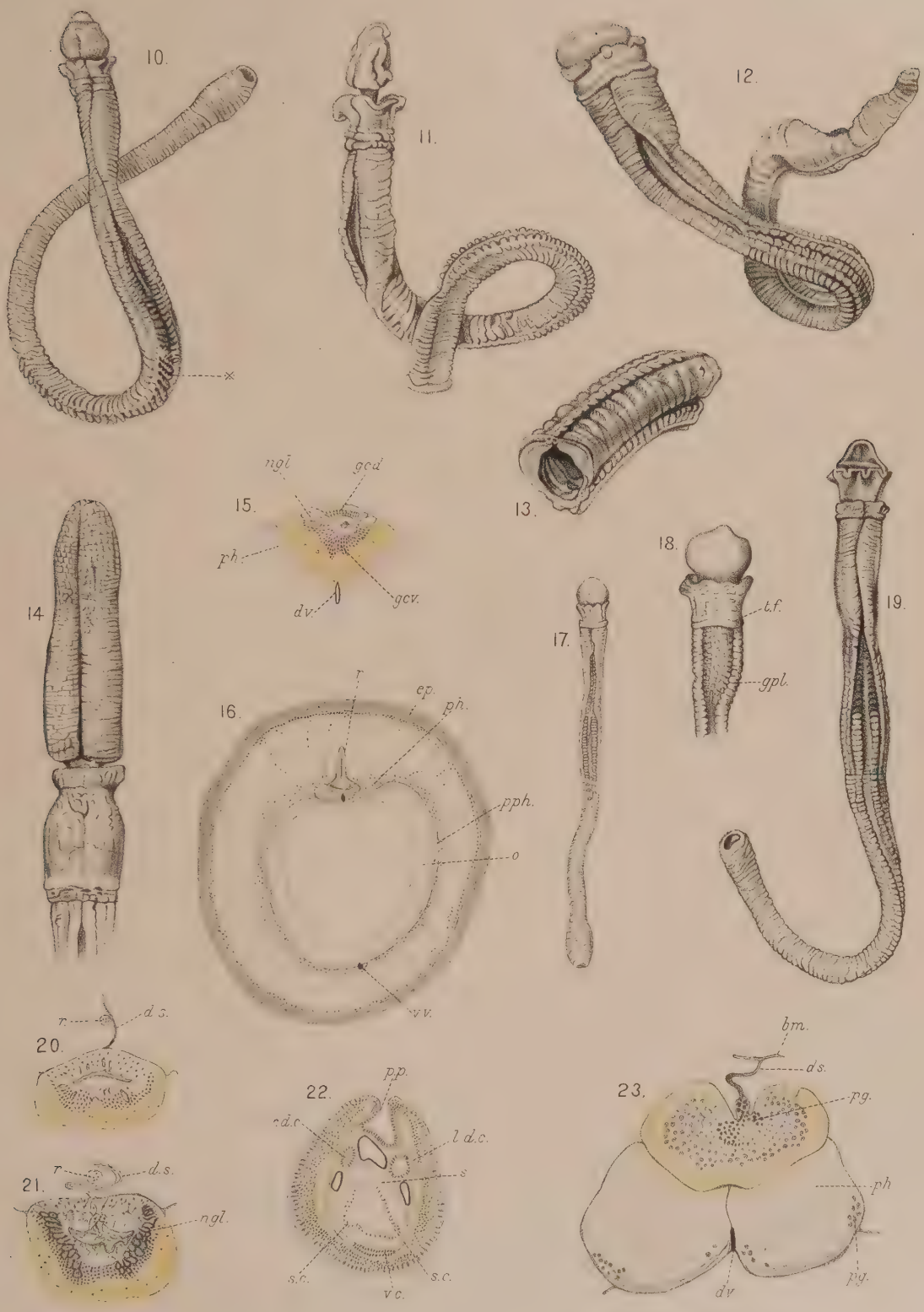

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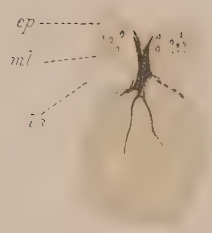

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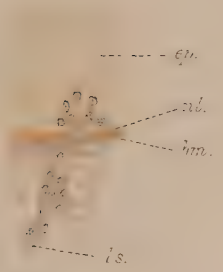

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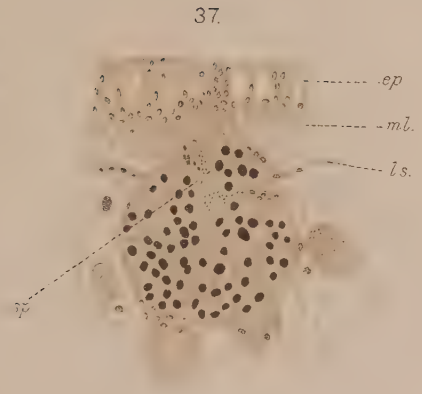

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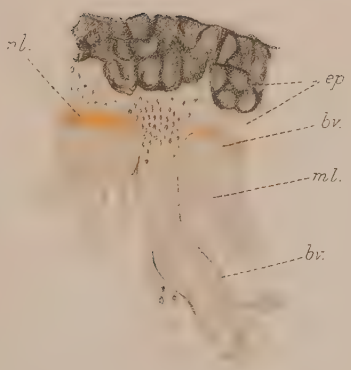

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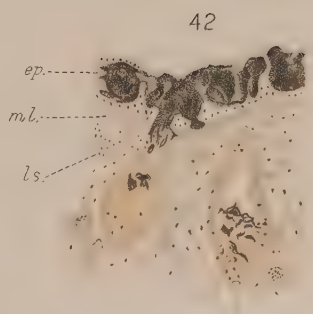

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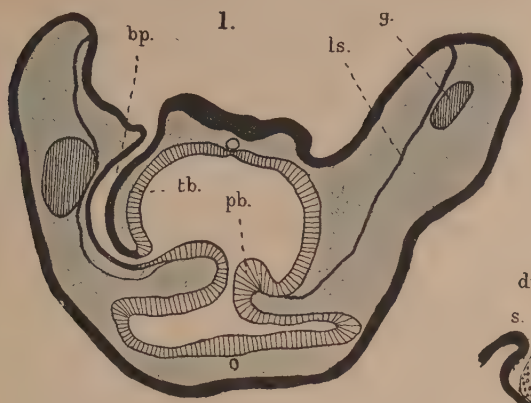

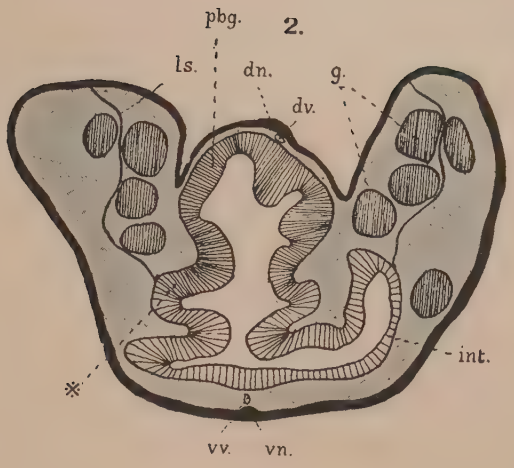

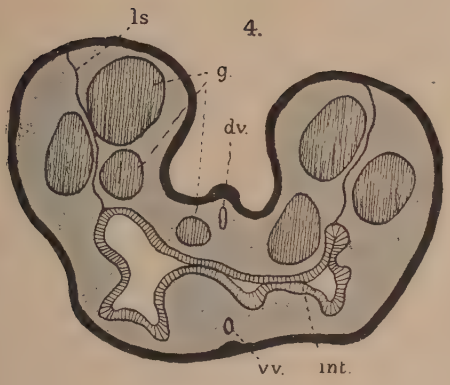

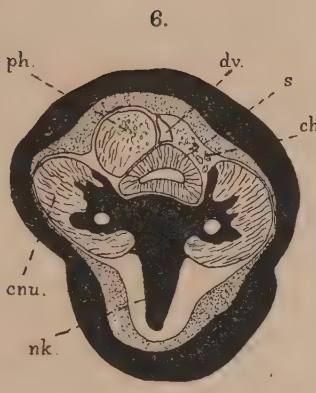

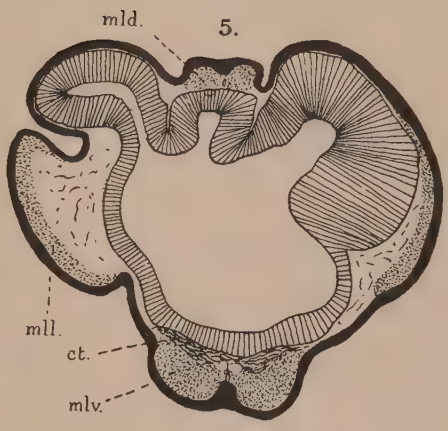

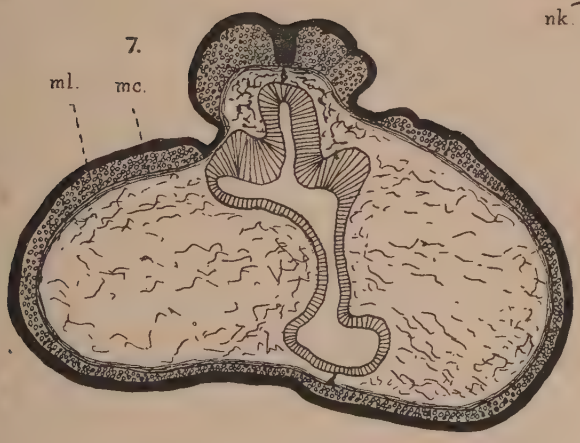

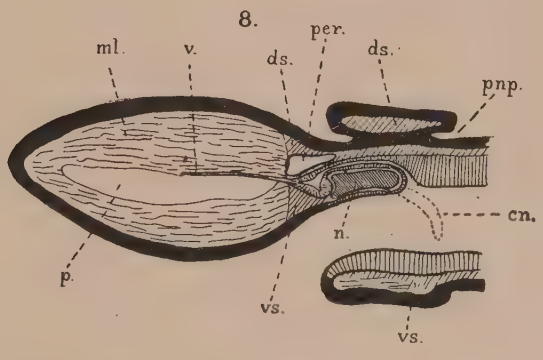

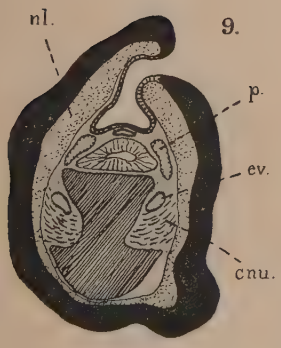

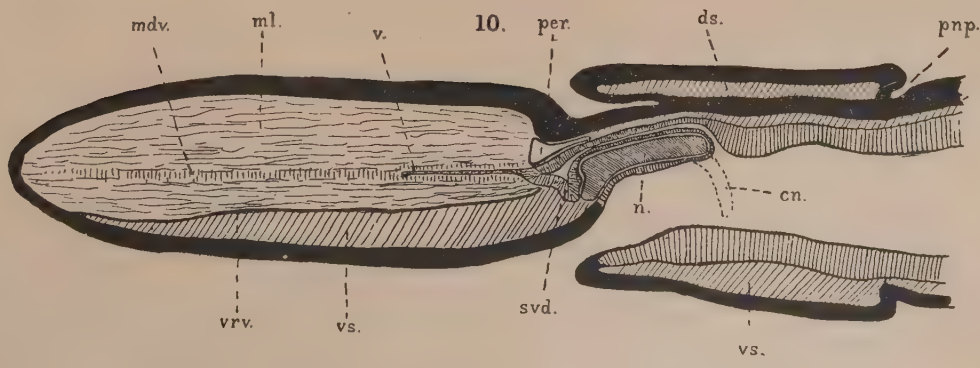

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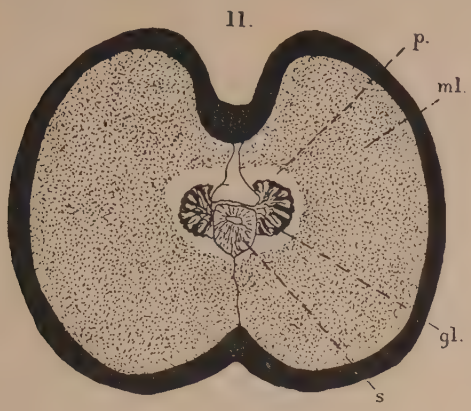

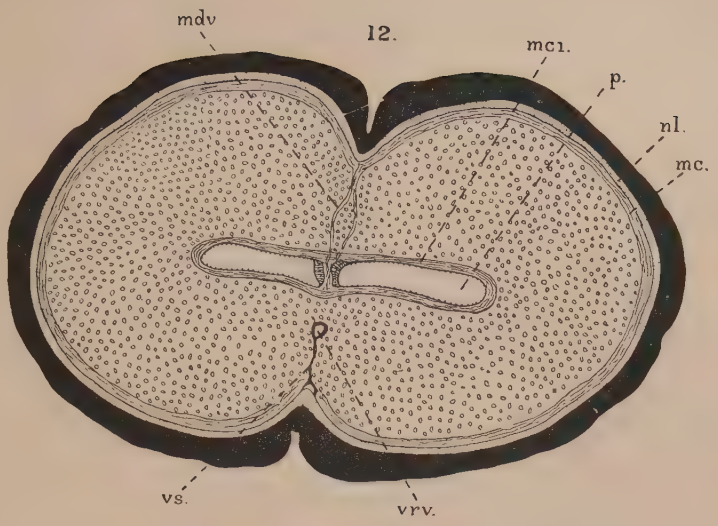

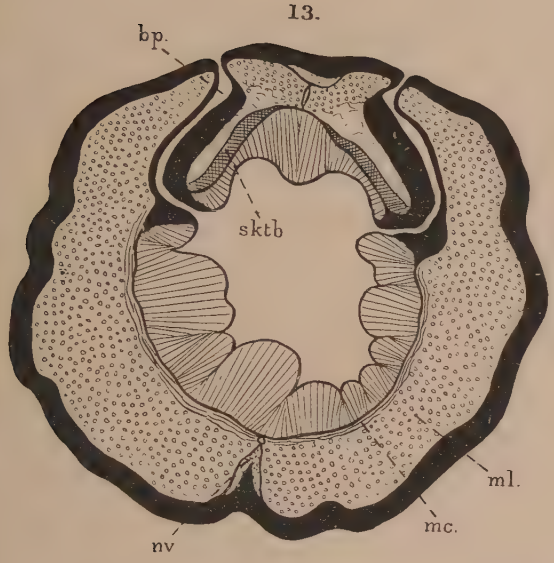

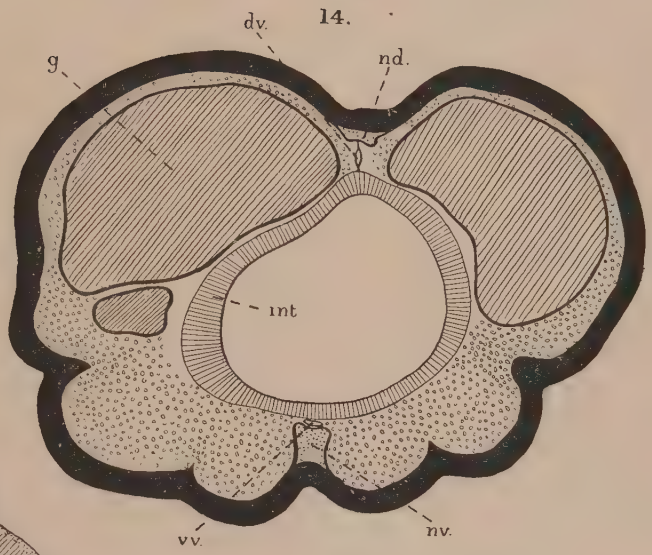

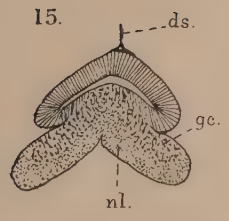

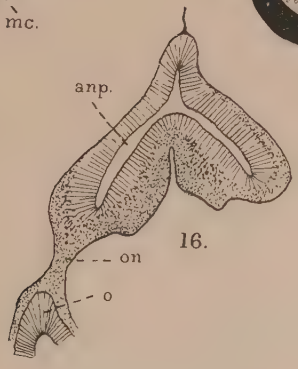

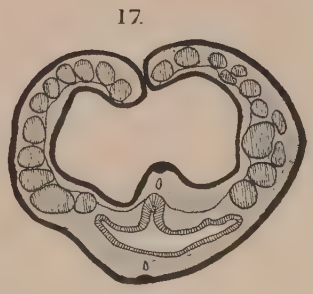

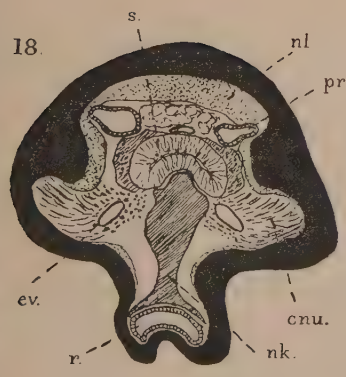

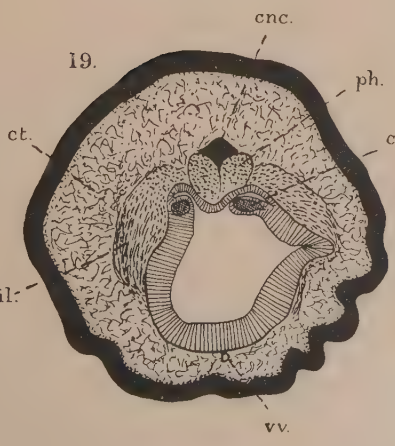

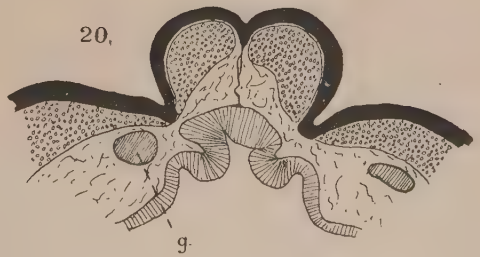

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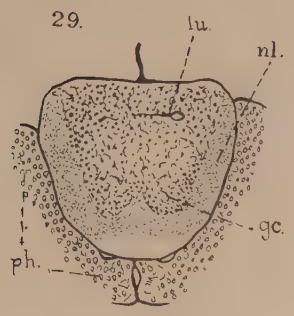

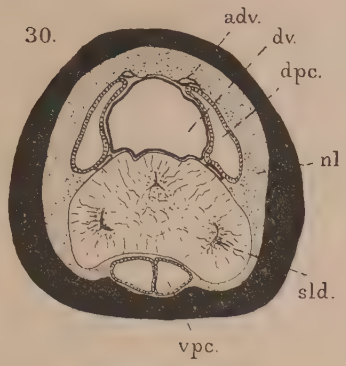

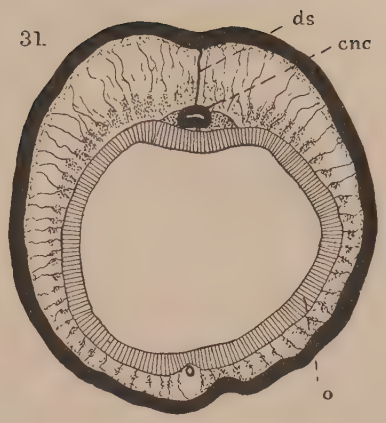

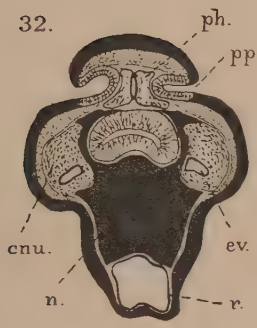

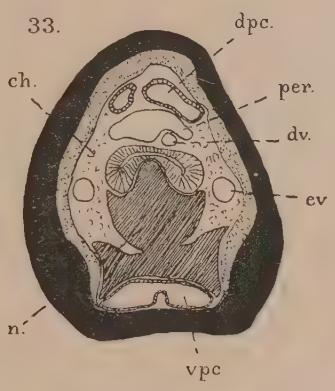

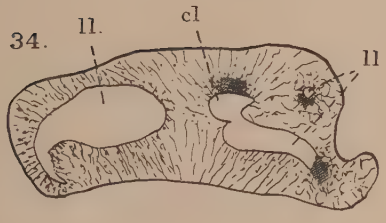

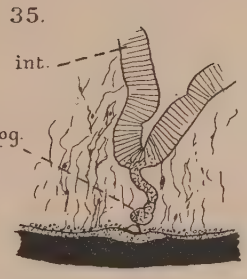

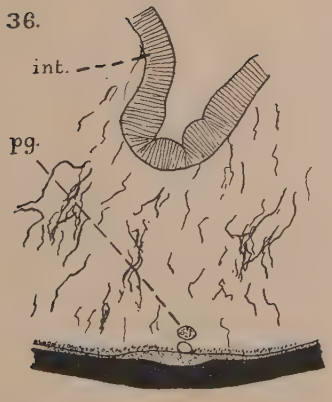

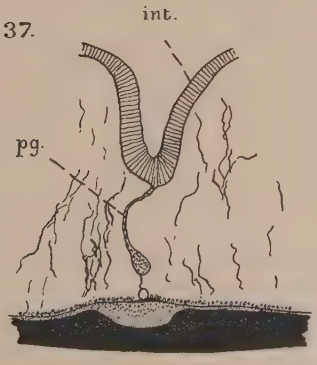

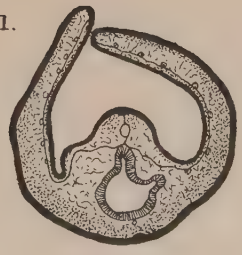

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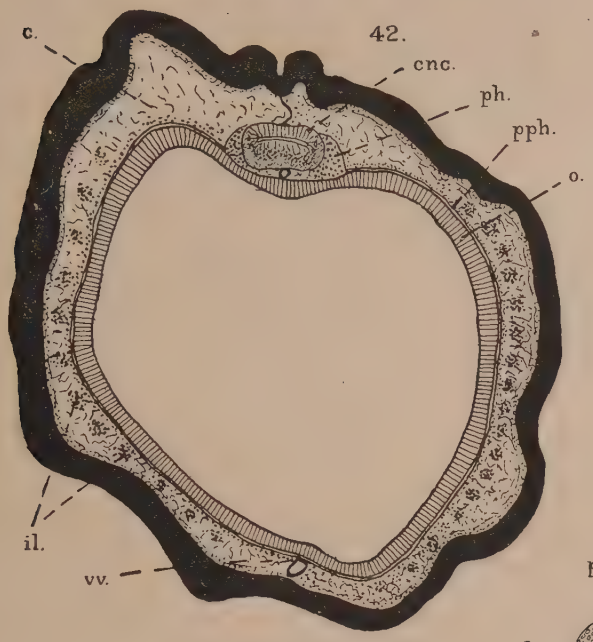
PUNNETT——ENTEROPNEUSTA.



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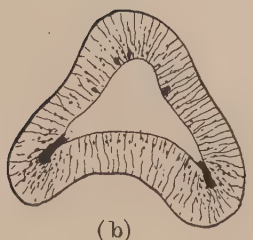

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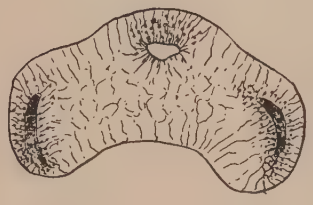

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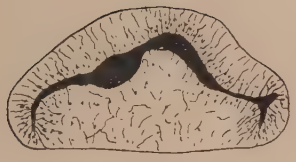

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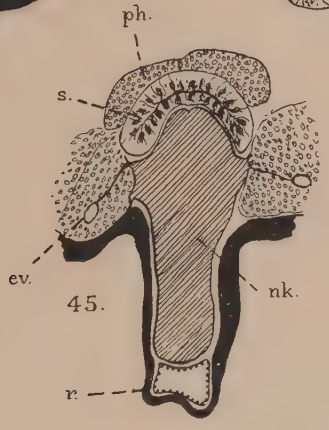

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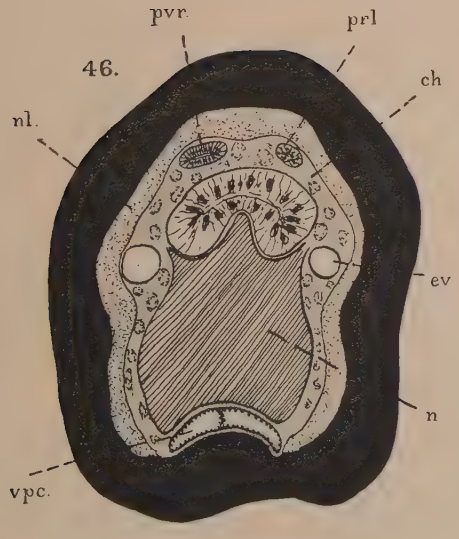

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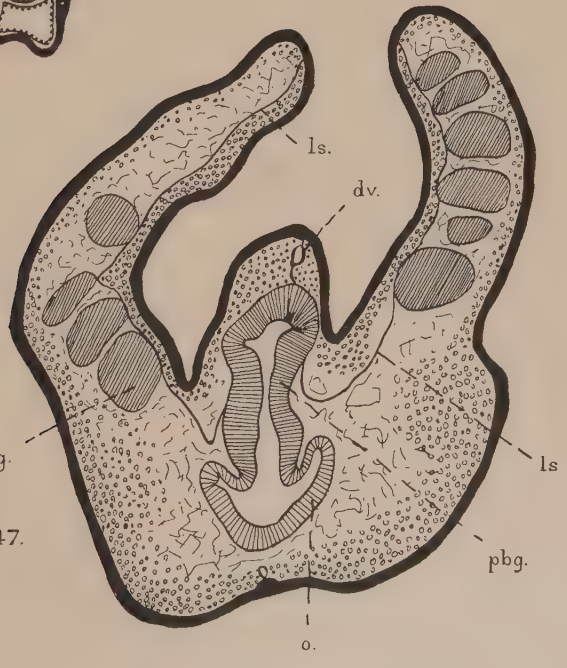

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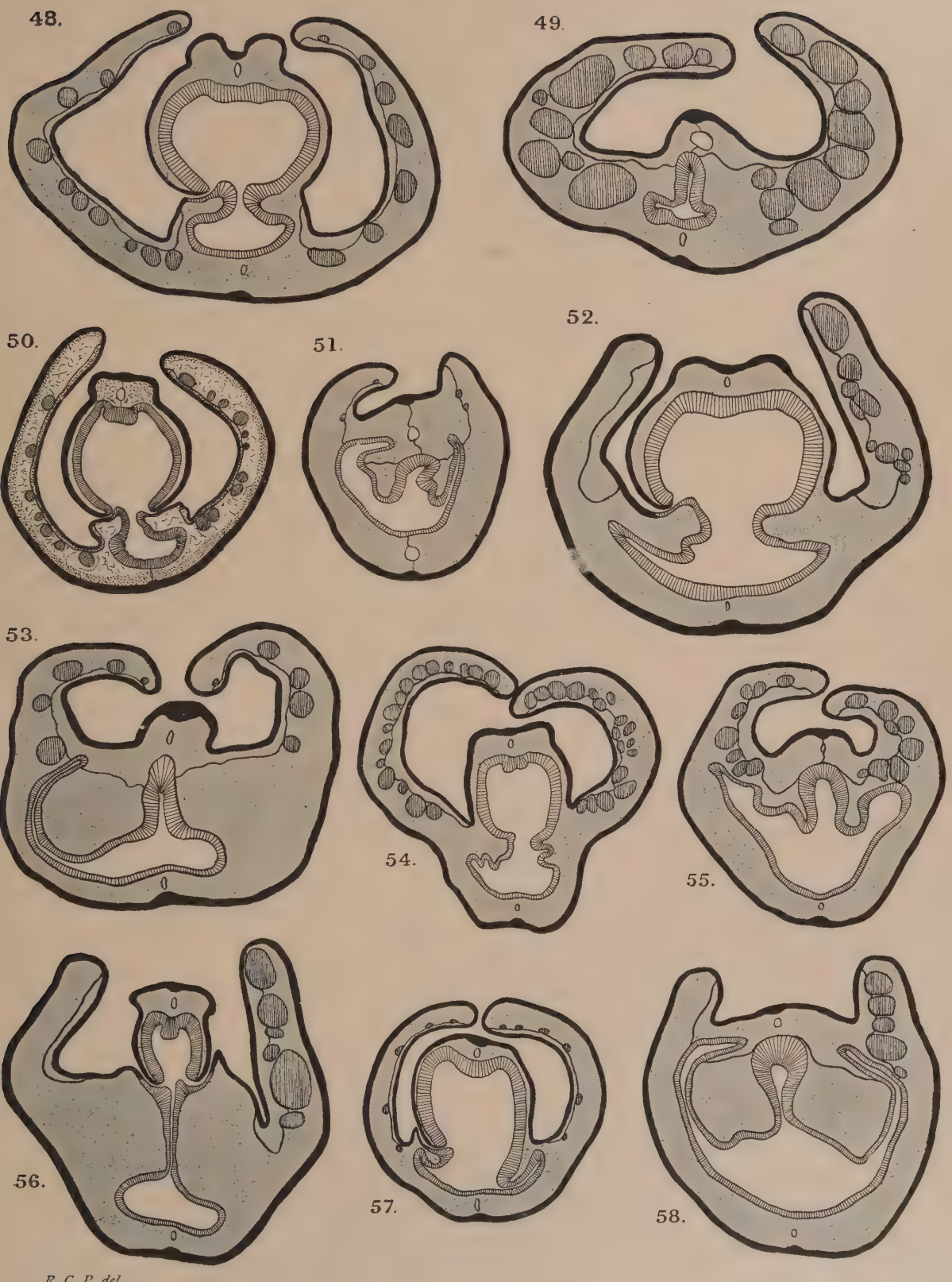
PUNNETT——ENTEROPNEUSTA.



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PUNNETT——ENTEROPNEUSTA.

MARINE CRUSTACEANS.

PARTS X. AND XI.

By L. A. Borradaile, M.A., *Lecturer in Natural Sciences at Selwyn College, Cambridge.*

(With Plates XLVII. and XLVIII. and Text-figures 122—6.)

X. THE SPIDER-CRABS (OXYRHYNCHA).

The Oxyrhyncha are a fairly well characterized group. Sharply separated, on the one hand from the Dromiacea by the coxal opening of the oviduct, the loss of the first abdominal limb in the female, and the normal shape and position of the last pair of legs (except in two or three cases as *Ocinopus* (Fig. 123), *Grypachaeus* and *Zebrida*), and on the other hand from the Oxystomata by the square mouth and the normal maxillipeds (Pl. XLVII. fig. 5 *b*), they differ from the Brachyrhyncha in the shape of the body, which is narrowed in the fore part, so that in most cases it is triangular, and has a well-marked rostrum (Pl. XLVII., and Text-figs. 122 and 123), and usually in the imperfection of the orbits. Slender legs and weak chelae are another common feature, but not a diagnostic one. Their prevailing habitat may be summed up by saying that they are the crabs of the weed and weed-like animals, but this statement needs some explanation and qualification.

The loss of their tail-fin has left the crabs, as a whole, a distinctly slower-moving group than most of the tailed Reptantia. To this there are, indeed, exceptions—as, for instance, the Ocypodes on land and the swimming crabs in the water—but for the bulk of the Brachyura it holds good, and each of the sections of the tribe has had to meet the difficulty in its own way. In the Brachyrhyncha the cuticle has generally become thickened into a stout armour, while the crab keeps fairly active in its habits, at all events after dusk, and usually defends itself vigorously with its strong chelae when it is attacked. In this legion protective coloration and shape are comparatively rare, and the habit of covering the body with foreign objects decidedly so (*Caphyra*), though the custom of hiding under stones is common. The remaining groups have, so to say, accepted the situation. Driven by the loss of their tail-fin to lead a sluggish life, they have found safety in exaggerating this inertness and combining it with various devices for escaping observation. The Dromiacea hold foreign bodies over their backs with their hind legs, the Oxystomes bury themselves in sand or shingle, and in each of these groups the most characteristic features, to which they owe their distinctness, are due to the method of concealment[1]. The

[1] See above, p. 434.

typical members of the Oxyrhyncha—the Maiidae[1]—have adopted another plan. They hide themselves by covering their bodies with bits of seaweeds, zoophytes, or sponges, which are held on by hooked or jagged hairs of special shape found on the body and limbs of the true spider-crabs and not elsewhere (Pl. XLVII. figs. 3 *c* and 4 *d*). They are gathered and placed in position by the crab itself, which uses for this purpose its chelipeds. These limbs are specially shaped so as to have a mobility not found in other crabs, and are thus able to reach distant parts of the body and legs. In order that they may adhere better, the fragments of weed, etc. are treated with a secretion given out by glands on the first maxilliped[2]; and they not only remain in a living state, but often continue to grow, so that in some genera it is not uncommon to find the whole crab as completely hidden by a single sponge as any *Dromia*. Besides seaweeds, the organisms used include sponges, hydroids, polyzoa, and ascidians, and in some cases barnacles and tubicolous worms add themselves as self-invited guests. Several different kinds of organisms may sometimes be found on the back of one crab, but in most cases, very possibly in all, the species planted by it are those amongst which it is living and are changed if it be placed in other surroundings where they would be conspicuous. This implies considerable care in the choice of the clothing, and indeed such may easily be seen to be bestowed if a captive individual, say a *Maia squinado*, be watched while it is disguising itself. I have even seen this species cover its back with shingle when no weed was available. The number of hairs naturally varies, as does also the extent to which the crab is hidden, but it rarely happens (*Epialtus*) that they are quite wanting.

[1] *Key to the families of the Oxyrhyncha.*

I. Carapace thin and flat. First leg (cheliped) not long or specially mobile or with fingers bent at an angle with the hand. Male opening sternal. [No orbits. Second joint of antennal stalk slender, fused with epistome but not with front. No hooked hairs.] *Hymenosomidae.*

II. Carapace not thin *and* flat (except *Ocinopus*). First leg either mobile or powerful with bent fingers. Male opening coxal.

A. Chelipeds specially mobile, rarely much larger than the other legs or with fingers bent at an angle on the hand. Second joint of antenna well developed, generally fused with epistome and often with front. Orbits generally more or less incomplete. Hooked hairs almost always present. *Maiidae.*

B. Chelipeds not specially mobile, usually much longer and heavier than the other legs and with fingers bent on the hand at an angle towards the side on which the fixed finger is set. Second joint of antenna small, short, and not fused with epistome or front. Orbits well made. Hooked hairs almost always wanting. *Parthenopidae.*

Key to the subfamilies of the Maiidae.

I. Second joint of antenna very slender throughout its length. [No orbits. Eyestalks generally long.] *Inachinae.*

II. Second joint of antenna not very slender.

A. No true orbits (eyestalks hidden under a supraocular spine or sunken in the sides of a great rostrum). Second joint of antenna truncate-triangular. Eyestalks very short. *Acanthonychinae.*

B. True orbits, containing both supra- and postocular elements sheltering the eyes, are more or less completely formed, except in a few genera where the eyestalks are long and slender. Second antenna-joint broad, usually not truncate-triangular. Eyestalks long or short.

1. A large, cupped, usually blunt postocular process present. Eyestalks short. Cornea of eyes not completely hidden when they are folded back. *Pisinae.*

2. Postocular process, if present, usually sharp and not cupped, but if not so then cornea hidden (as also in most other cases). Eyestalks usually long. *Maiinae.*

Key to the subfamilies of the Parthenopidae.

I. Carapace usually triangular, sometimes suboval or subpentagonal. Rostrum simple. Chelipeds much bigger than the other legs. Branchial regions of the body deeply separated from cardiac. *Parthenopinae.*

II. Carapace usually sharply pentagonal. Rostrum cleft into two. Chelipeds of moderate size. Branchial regions of the body not deeply separated from cardiac. *Eumedoninae.*

[2] For an account of those structures in the Spider-Crabs which are specially adapted to their habit of clothing themselves, see Aurivillius, *Kong. Svenska Vet.-Ak. Hand. Bt.* XXIII. no. 4 (1889).

Such habits as these need a corresponding habitat, and the Spider-Crabs are essentially haunters of weeds, and weed-like animals. The larger kinds cling to the rocks and stones on which grow the organisms they clothe themselves with. The walking-legs of such species usually end in strong, sharp, curved claws by which they can hold fast to the ground. Smaller kinds often live on the weed itself, and these frequently bear hooked or even sub-chelate claws on the hinder legs with which to cling to the branches, while one or both of the second and third pairs are long—probably because they are used in climbing (Pl. XLVII. figs. 1, 3 and 4). The first pair (chelipeds) are also sometimes used, monkey-wise, in clambering. Research will no doubt show that some of the peculiar features of particular species and genera are adaptations to special kinds of sessile organisms. At present I can only recall the flat, leaf-like body of *Huenia*, which resembles the *Halimeda*-weed among which it is generally found (see below, p. 686), and it is certainly the case that very many species show no preference whatever in this respect.

The habit of living on or among sessile organisms is probably kept up by some of the members of the other two families of the Oxyrhyncha, although it is the Maiidae alone which clothe themselves in the way described above. Further information, however, is much needed on this point. The Hymenosomidae (Fig. 122) seem clearly adapted by their structure—their delicate bodies and slender legs with hooked end-joints—for living on plants or zoophytes. They may certainly sometimes be found in such situations, but are also reported to have been taken under stones[1], a position for which their flat backs are not unsuitable. Among the Parthenopidae, the Eumedoninae are probably guests of other organisms. *Zebrida* has, indeed, been taken among the spines of a sea-urchin whose colouring it assumes. But the Parthenopinae (Pl. XLVII. fig. 5) have an entirely different habitat. The members of this subfamily have left the weed (that they originally had the same habits as the Maiidae seems likely from the occurrence of hooked hairs, slight and few in number, in certain members of the genus *Lambrus*) and have taken up the same habitat as the Oxystomata—that is to say beds of sand and shingle. The result is a series of modifications strikingly like some of those which are found in the latter group[2]. The overlapping wings of the carapace which hide the legs of *Calappa* and *Tlos* reappear in such forms as *Cryptopodia*, *Heterocrypta* and *Oethra* and less strongly marked in *Lambrus*, especially *L. calappoides*. The long chelipeds of some Leucosiids are repeated in an altered shape in various species of *Lambrus* and *Parthenope*. The bent fingers of *Ranina* and some species of *Calappa* are found throughout the group. In *Lambrus calappoides* we find again the flat hands of *Calappa* held against the breast. But the most striking of these likenesses is the arrangement of the inward channel for the breathing-stream in *Aulacolambrus*, which, while it is wholly new, yet strongly recalls that of the Leucosiidae. In this subgenus, the underside of the carapace (pterygostome) is traversed, on each side, just outside the third maxilliped, by a deep groove which is covered in, not like the analogous channel in the Leucosiidae by the maxillipeds, but by thick fringes of hairs borne by the maxillipeds and by the carapace, becoming thus a closed tube leading from the front of the body to the opening of the gill-chamber at the base of the chelipeds (Pl. XLVII. fig. 6). A similar

[1] Adams and White, *Crustacea of the Samarang*. The authors make the same statement about *Trapezia*, which is certainly a coral crab. Perhaps these genera take shelter under stones when they are by some accident removed from the neighbourhood of their natural habitat, growing organisms. Or, again, it may be that the hollows under the stones from which the *Elamena* was taken were lined, as such hollows often are, with a scrubby growth of weed.

[2] See above, pp. 434, 435.

arrangement is found in the other subgenera of *Lambrus*[1]. In this case, however, there are two shallow grooves, an outer one running outward and an inner one running forward from the gill-opening, and both uncovered (Pl. XLVII. fig. 5 *b*). The rough, knobbed back of the Parthenopinae is like that of *Calappa*, but a similar texture is so common among crabs that little can be argued from it. Probably it is less conspicuous on a sandy bottom with coral pebbles than a quite smooth object would be.

We have already stated that the Oxyrhyncha are among the sluggish groups of crabs. When they are seized they do not attempt to defend themselves with their chelae, but move their legs feebly and aimlessly. Indeed the Parthenopinae—like the Calappidae in this respect also—often seem to be hypnotised by being moved, drawing up their legs under them and remaining still. In general the intelligence of the group is of a low order, with the single exception of their cleverness in disguise, which, after all, is probably no more than a fairly simple reflex.

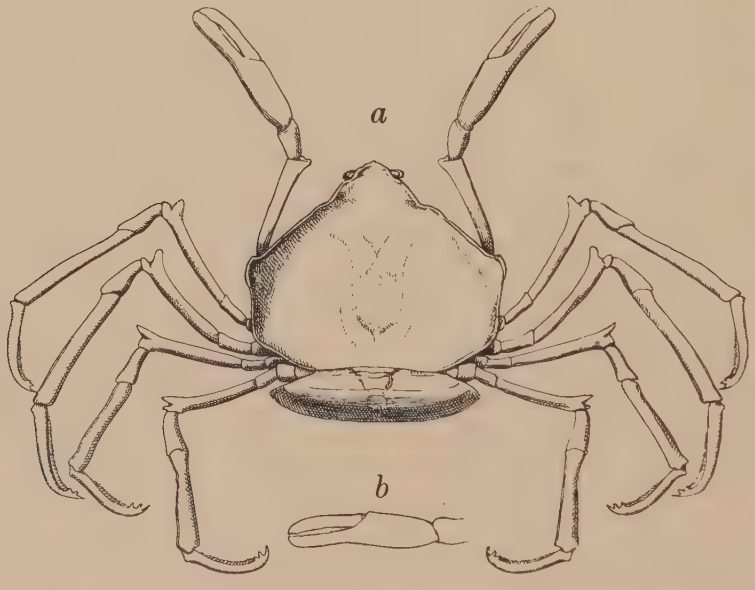


Fig. 122. *Elamena gracilis*; *a*. whole animal, *b*. outside of hand.

Of the 29 species in the collection made by the expedition, three are new. The rest are all recorded from the Indian region by Major Alcock[2], with the exception of two which were described as new by Miss Rathbun in her account of Prof. Agassiz's Maldive Crabs[3]. The following systematic list sets forth these species in order.

Family **Hymenosomidae.**

Genus *Elamena* H. M.-Edw., 1837.

1. *Elamena gracilis*, n. sp. (Fig. 122)

Diagnosis: "An *Elamena* in which the sides of the hinder part of the body are straight from the 4th to the 1st pair of legs, and then turn inwards almost at right angles to

[1] Owing to lack of material I am unable to say whether this groove is found throughout Parthenopinae.

[2] In his series of papers on the Indian Crabs in the *Journ. As. Soc. Bengal.*

[3] *Bull. Mus. Harvard*, xxxix. 5 (1902).

join the fore part, which is triangular, with very slightly irregular sides; the front also triangular but with indications of two teeth at its sides; the eyes showing a small part of the cornea at the sides of the front when seen from above; the chelipeds short, slender, with narrow, spooned fingers about as long as the palms; and the walking-legs slender, with a spine at the end of the meropodite, and the last joint strongly hooked, with a group of little thorns underneath at the tip and a fringe of hair all along."

Length of longest specimen: 6 mm. Breadth: 7 mm. Colour: in spirit, pale yellow; when alive, legs black-brown, rest of body transparent.

A female was taken at Minikoi, and a male and female at Hulule, Male Atoll, all on the reef.

Family **Maiidae.**

Subfamily **Inachinae.** Genus *Achaeus* Leach, 1815.

2. ?*Achaeus spinosus* Miers, 1879. Alcock, I. p. 171[1].

My specimen agrees with Alcock's and Miers' descriptions, but the last *two* pairs of legs have strongly curved end-joints. Miers and Alcock only mention the last pair.

Dredged in Mahlos Atoll in 24 fathoms.

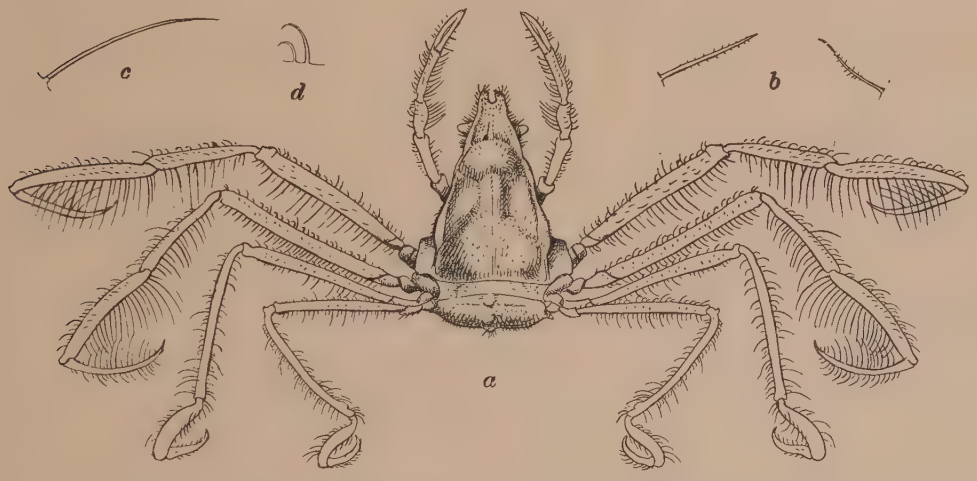


Fig. 123. *Ocinopus aranea*; *a*. whole animal, *b*. two of the hairs on the hinder pair of legs, *c*. one of the long hairs on the legs of the second and third pairs, *d*. hooked hairs.

Genus *Ocinopus* de Haan, 1837.

3. *Ocinopus aranea* de Haan, 1837. Alcock, I. p. 183 (Fig. 123).

The shape of the lobes at the tip of the rostrum in this species varies somewhat.

A very common crab, taken practically throughout the group in 19—45 fathoms.

[1] For a statement of the principles on which references are given in this series of papers see above, p. 192. Major Alcock's paper on the Indian Oxyrhyncha appeared in *Journ. As. Soc. Bengal*, LXIV. ii. 2, p. 157 (1895).

Subfamily **Acanthonychinae.** Genus *Xenocarcinus* White, 1847.

4. *Xenocarcinus tuberculatus* White, 1847. Alcock, I. p. 192.

Dredged outside Fadifolu Atoll, in 70 fathoms.

Genus *Menaethius* H. M.-Edw., 1834.

5. *Menaethius monoceros* (Latr.), 1825. Alcock, I. p. 197.

A common species, taken in Male, Fadifolu, Minikoi, and Goifurfehendu Atolls down to 6 fathoms.

Genus *Huenia* de Haan, 1837.

6. *Huenia proteus* de Haan, 1837. Alcock, I. p. 195 (Pl. XLVII. figs. 1, 2).

In the extraordinarily variable shape of its body, this crab is fully worthy of its name. The simplest form is found in most of the males, which are flat and triangular, much like *Menaethius*, with a long, sharp rostrum (Pl. XLVII. fig. 1). What may be the habitat of these males is yet to be settled: the specimen figured carried a large flat piece of a green weed, held on its rostrum by means of the hooked hairs always found there in this species. On the other hand, most of the females and some of the males—true males, not "unsexed females" with parasites—have the body widened into a leaf-like shape by outgrowths of the hepatic and branchial regions (Pl. XLVII. fig. 2). These individuals, at least in most cases, live on the flat *Halimeda*-weed, which they closely resemble both in shape and colour. Figure 124 is given to show this likeness. Some of the females, however, come near the three-cornered shape of the ordinary male. This, and the fact that intermediates are found in both sexes, prevents us from calling the phenomenon "dimorphism." Another interesting feature is shown by the walking legs. The last joint in these limbs is strongly toothed, and can be shut back at a sharp angle on the one before it. In the broad individuals the legs are short and stout and keeled to look like the edges of *Halimeda* "leaves," and here the whole under-edge of the last joint but one is hairy; but in the triangular form, where the legs are long and slender, there is a special tuft of hairs to meet the end-joint, and this tuft is often raised on a knob. The whole structure thus formed is all but subchelate and seems clearly adapted for holding on by.

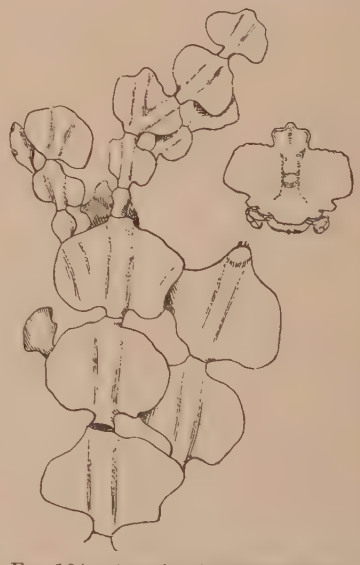


Fig. 124. A sprig of *Halimeda*-weed with a specimen of *Huenia proteus*, showing the likeness of the latter to a "leaf" of the weed.

The surface of the body of these crabs may be seen under a high magnification to have the curious graving shown in fig. 1 *a*, on Plate XLVII.

The species was taken in Male Atoll on the reef, and dredged from 22 fathoms in Kolumadulu Atoll.

Subfamily **Pisinae.** Genus *Naxioides* A. M.-Edw., 1865.

The synonymy of this genus is discussed by Rathbun, *Proc. Biol. Soc. Washington,* XI. p. 157 (1897).

7. *Naxioides hirta* A. M.-Edw., 1865.

Naxia hirta, Alcock, *loc. cit.* p. 218.

Taken in Kolumadulu, Suvadiva, Haddumati, and South Nilandu Atolls in 30—40 fathoms.

8. *Naxioides spinigera,* n. sp. (Pl. XLVII. fig. 3).

Diagnosis: "A *Naxioides* with the horns more than half the length of the body, bearing the accessory thorn a third of their length from the end; the body hairy, with many knobs and thorns, of which the largest are three in a row on the gastric region, two on the cardiac, one on the intestinal, three in a triangle on the branchial, with one in front of them, and one on each eye-hood, these latter being quite upright, but bent slightly forwards at the tip, no thorn at the angle of the mouth, two knobs on the pterygostome, two thorns on the outside of the basal joint of the antenna; the chelipeds slender, little longer than the body, the fingers half the length of the palm, finely toothed and meeting along nearly their whole length, a spine at the end of the arm; and the walking legs slender, the first pair very long, a long spine at the end of the meropodite of this limb, a short one on the next, and none on the hinder two."

Length: 11 mm. Breadth: 8 mm. Colour in spirit: white.

Allied to *N. cerastes* (Ortm.), 1894.

Three males dredged in 30 fathoms in North Male Atoll.

Genus *Halimus* Latr., 1829.

For the synonymy of this genus, which is identical with *Hyastenus* White, 1847, and not *Naxia* Leach, 1828, see Rathbun, *Proc. Biol. Soc. Washington,* XI. p. 157 (1897).

9. *Halimus tenuicornis* (Pocock), 1890. Alcock, I. p. 215.

The colour of this species as preserved in formalin is white with bright pink markings. It was dredged in South Nilandu, Male, Mulaku, Felidu and North Male Atolls in 25—30 fathoms.

10. *Halimus gracilirostris* (Miers), 1879. Alcock, I. p. 215.

Dredged throughout the group in 20—70 fathoms.

11. *Halimus diacanthus* (de Haan), 1837. Alcock, I. p. 210.

Found on a black crinoid dredged in 30 fathoms in South Nilandu Atoll.

12. *Halimus calvarius* (Alc.), 1895. Alcock, I. p. 213.

Dredged in South Nilandu, Mulaku, Suvadiva, Haddumati, and North Male Atolls in 19—40 fathoms.

13. *Halimus convexus* (Miers), 1884. Alcock, I. p. 216.

The one specimen in the collection is a female, and differs from Miers' (a male) in that: (i) the horns are less strongly divergent, (ii) the palm is slenderer and the fingers much less

gaping. The species is allied to *H. calvarius* but differs in that: (i) the horns are more slender and diverge more strongly, curving, as well as slanting, outwards, (ii) there is no trace of a knob on the gastric mound, which is also more prominent, (iii) there is no epibranchial spinule or intestinal spine, (iv) the carapace is narrower, and (v) the palm is rather more swollen. It was dredged in 30 fathoms in Suvadiva Atoll.

14. *Halimus espinosus*, n. sp. (Pl. XLVII. fig. 4).

The group of forms akin to *H. diacanthus* (including var. *elongata* Ortm., 1893, *H. subinermis* Zehnter, 1894, *H. convexus* Miers, 1884, and *H. calvarius* Alc., 1895) are in all likelihood no more than varieties of one variable species. The collection contains a specimen of another such form, which I describe here. The following characters, taken together, separate it from its allies mentioned above: (i) carapace narrow (10 : 6); (ii) gastric region swollen, with traces of the knob; (iii) horns rather less than half the length of the carapace, straight, not very divergent; (iv) a spinule on each branchial region and a low knob in place of the intestinal spine; (v) the outer angle of the basal antennal joint not strongly marked. The specimens, which are both males, were dredged in Haddumati Atoll in 35 and 39 fathoms.

15. *Halimus agassizi* Rathb., 1902.

Halimus agassizii, Rathbun, *Bull. Mus. Harvard*, XXXIX. 5, p. 133, fig. 6.

The females of this species have very slender chelipeds with long narrow palms and short fingers, which gape very slightly. Miss Rathbun's only specimen was taken in the same locality as ours, Nilandu Atoll, and in practically the same depth, 24 fathoms.

Genus *Phalangipus* Latr., 1825.

Miss Rathbun (*Proc. Biol. Soc. Washington*, XI. p. 159, 1897) has shown that this name must be substituted for *Egeria* Leach, 1815, which is preoccupied.

16. *Phalangipus arachnoides* Latr., 1825. Alcock, I. p. 223.

Dredged in Mulaku, South Nilandu, and Felidu Atolls, in 25—36 fathoms.

Genus *Tylocarcinus* Miers, 1879.

17. *Tylocarcinus styx* (Hbst.), 1803. Alcock, I. p. 235.

Taken on the reef in Male, Fadifolu, and Goifurfehendu Atolls.

Subfamily **Maiinae.** Genus *Schizophrys* White, 1848.

18. *Schizophrys aspera* (A. M.-Edw.), 1834. Alcock, I. p. 243.

Taken on the reef in Male and Fadifolu Atolls, and dredged in 34 fathoms in Felidu and 20 fathoms in Suvadiva Atoll.

Genus *Cyclax* Dana, 1852.

19. *Cyclax* (*Cyclomaia*) *suborbicularis* (Stimps.), 1857. Alcock, I. p. 245.

Taken on the reef at Hulule, Male Atoll.

Genus *Micippa* Leach, 1816.

20. *Micippa philyra* (Hbst.), 1803. Alcock, I. p. 249.

Taken on the reef at Hulule, Male Atoll, and dredged in Kolumadulu, South Nilandu, Fadifolu, Suvadiva and North Male Atolls in 20—35 fathoms.

21. *Micippa margaritifera* (Hend.), 1893. Alcock, I. p. 253.

Dredged in Suvadiva Atoll in 43 fathoms.

22. *Micippa parca* Alc., 1895. Alcock, I. p. 253.

I think that this form should have specific rank, rather than that of a variety of *M. margaritifera*, given to it by Alcock.

Dredged in 20 and 25 fathoms in Mahlos and South Nilandu Atolls respectively.

Genus *Macrocoeloma* Miers, 1879.

23. *Macrocoeloma nummifer* Alc., 1895. Alcock, I. p. 255.

Almost all the spines on my specimens end in a round knob. Alcock does not mention this, but such knobs were present on several of the spines in the individual he figures. In my specimen thickenings of a like kind are set on the tips of the front. Alcock's figure, however, shows none. The knobs cannot be rubbed off and do not seem to be due to foreign growths of any kind.

The species was dredged in 30 fathoms in South Nilandu, and in 23 fathoms in Mahlos Atoll.

Family **Parthenopidae.**

Subfamily **Parthenopinae.** Genus *Lambrus* Leach, 1815.

24. *Lambrus* (*Rhinolambrus*) *bispinosus* Rathb., 1902.

Lambrus (*Rhinolambrus*) *bispinosus*, Rathbun, *Bull. Mus. Harvard*, XXXIX. 5, p. 134, figs. 1, 2.

In her description of this species, Miss Rathbun says that the upper side of the hand bears *two* lobes. Later she says that the species is separated from *L. confragosus* (among other differences) by the presence of only *one* lobe in this position. Her figure and my specimens bear out the latter statement.

Dredged in South Nilandu Atoll in 25 fathoms.

25. *Lambrus* (*Rhinolambrus*) *pelagicus* Rüpp., 1830. Alcock, I. p. 267.

The granules on the back are quite well marked in my specimens, as in Milne-Edwards' figure (*Nouv. Arch. Mus.* VIII. Pl. XIV. fig. 4). It would seem that Alcock had found in the Andamans local races both of this species and of *L. gracilis*, in which the granules were reduced in size and distinctness.

Dredged in Mulaku, Suvadiva, and Addu Atolls, in 28—43 fathoms.

26. *Lambrus* (*Rhinolambrus*) *gracilis* Dana, 1852. Alcock, I. p. 269.

The specimens which I assign to this species agree with Alcock's description fully, except that the surface of the carapace is not absolutely smooth, there being several granules round the cardiac spine and along the branchial ridges.

Dredged in Felidu, Fadifolu and Suvadiva Atolls, in 22—43 fathoms.

27. *Lambrus* (*Rhinolambrus*) *turriger* Ad. and Wh., 1847. Alcock, I. p. 269 (Pl. XLVII. fig. 5).

Dredged in South Nilandu, Felidu, Mulaku, Haddumati, Suvadiva, Kolumadulu and North Male Atolls, in 25—42 fathoms.

28. *Lambrus* (*Aulacolambrus*) *sculptus* A. M.-Edw., 1872. Alcock, I. p. 272 (Pl. XLVII. fig. 6).

Dredged in South Nilandu, Felidu, Mulaku, and Suvadiva Atolls, in 20—43 fathoms.

29. *Lambrus* (*Parthenolambrus*) *calappoides* Ad. and Wh., 1847. Alcock, I. p. 275.

Dredged in South Nilandu and Suvadiva in 36 and 35 fathoms respectively.

XI. ON THE CLASSIFICATION AND GENEALOGY OF THE REPTANT DECAPODS.

Besides the brachyurous Crabs, Boas' Reptantia[1] comprised sundry groups which are not brachyurous, that is have a pair of biramous limbs on the sixth segment of the abdomen, which bears traces of adaptation to other purposes than reproduction, such as swimming or holding on a shell, and have also no fusion between the rostrum or front and the epistome and no angle on the endopodite of the first maxilliped. The following are the names of these groups: Eryonidea, Scyllaridea (= Loricata), Nephropsidea (= Homaridea and Astacidea), Thalassinidea, Paguridea, Galatheidea, and Hippidea, the last three being together known as Anomala by Boas and most other writers.

Our present object is to arrange these divisions according to their relationships, and to do this we must first of all form an idea of the ancestor from which they may be supposed to be descended. More space would be needed than can be spared here to set forth in detail the process of comparison of the various types with one another and with the prawns of the Stenopidea and Penaeidea, by which this result may be reached, and indeed this might after all be hardly worth while, for the following statement will, I think, commend itself to those who have studied the subject as on the whole probable.

The forebears of the reptant Decapods, if they could be examined, would probably show the following characters:

(1) The *rostrum* of a good size, flat but keeled, and narrowly triangular.

(2) The *carapace* subcylindrical, free from the epistome both at the sides and in the middle, overlapped behind by a process of the first abdominal segment on each side, and marked by the following grooves: on the back two running transversely (the first, line *e* of Boas, is Bouvier's

[1] See above, Art. IV. vol. I. p. 424.

cervical groove, and the second, line *c* of Boas, is Bouvier's branchial groove, ordinarily known as the cervical groove; it would be well if these were known as the first and second cervical grooves); at the sides three transverse grooves slanting forwards, the first two being prolongations of the two cervical grooves and the third being line *a* of Boas; and two irregular longitudinal grooves, the upper, line *d* of Boas, connecting the first cervical groove with the fore edge below the antenna, and the second, line *b*, *b*[1] of Boas, starting from the lower end of *a* and joining the lower ends of the two cervical grooves with the fore edge some way below the line *d*[1] (see Fig. 125).

(3) The *abdomen* long, straight, tapering somewhat from the second segment backwards, moderately broad, not greatly compressed but with pleura bent downwards and terga well arched. Both terga and pleura stout and overlapping. The telson pointed.

(4) The *eyes* well developed and pigmented. The eye-stalks of moderate length, made up of two cylindrical joints, of which the second is longer than the first.

(5) The *first antenna* with a straight stalk of three short, subequal subcylindrical joints, and two subequal flagella, which are longer than the stalk, but shorter than the flagellum of the second antenna.

(6) The *second antenna* with the basal joint free, a scale which is broad but not leaf-like and ends in a sharp point that represents the tooth on the outer angle in the prawns, and a flagellum which is slender and about as long as the body.

(7) The *mandible* with a broad cutting edge, a small stump to represent the molar process, and a stout, curved, three-jointed palp.

(8) The *first maxilla* with the plate which represents the basipodite broader than that which represents the coxopodite, and the endopodite of a good size, and divided into two joints, the second of which is directed outwards.

(9) The *second maxilla* with the coxopoditic and basipoditic plates both cleft, so that four lobes result, these lobes all narrow, and the scaphognathite ending behind in an angle, which is rather less than a right angle.

(10) The *first maxilliped* with a many-jointed flagellum on the exopodite, a two-jointed endopodite which is not very broad and an epipodite. The basipoditic plate deep, but not broad.

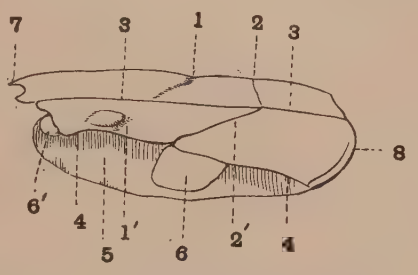


FIG. 125. Cephalothoracic carapace of *Callianassa novaebritanniae* from the left side, 1. first cervical groove—the line *e* of Boas and "cervical groove" of Bouvier, 2. second cervical groove—the line *c* of Boas and Bouvier's "branchial groove," ordinarily known as the "cervical groove," 1′ and 2′. continuations of 1 and 2 at the sides of the carapace, 3. upper longitudinal line—the *linea thalassinica* and perhaps also the *linea homolica*—the front part of which is the line *d* of Boas, 4. lower longitudinal line—the *linea anomurica* and perhaps also the *linea dromiidica*—the front part of which is the line *b* of Boas, 5. a soft area at the side of the carapace, 6, 6′. hard plates in this area, 7. *rostrum*, 8. thickened hinder edge of the carapace. The second cervical groove is here represented only by a line or crack in the carapace. It is, however, in the same place as the cervical groove of other Callianassas, and there is a good deal of evidence that a groove may be represented by a crack. The *linea thalassinica*, for instance, is sometimes a groove in part of its length.

(11) The *second maxilliped* with the exopodite longer than the endopodite, carrying a jointed flagellum, and the endopodite slender, with the last joint at the end.

[1] A backward prolongation of the upper of these lines (*d*), known as the *linea thalassinica*, is found in many Thalassinidea, and a similar prolongation of the lower (*b*), known as the *linea anomurica*, in the Anomala. The *linea homolica* and *linea dromiidica* correspond in position with the first and second of these respectively, but as they are not continuous with *d* and *b* it is doubtful how far they can be looked upon as homologous. In any case the term *linea anomurica* loosely applied to the longitudinal suture of the Homolidae (as on p. 575 above) is wrong.

(12) The *third maxilliped* with the exopodite shorter than the endopodite, carrying a straight, jointed flagellum directed forwards, and the endopodite narrow, with separate ischiopodite and meropodite.

(13) All the *legs* seven-jointed. The first three pairs chelate with normal chelae, the first the greatest, equal, the fourth pair simple, the fifth pair simple (?) and having its last two joints slightly twisted so that, when the basal joints are pressed against the sides of the body, while the last joint of the fourth pair points downwards and backwards, that of the fifth pair points forwards and inwards[1].

(14) The *gills* many, including mastigobranchs and podobranchs on all the thoracic limbs but the last, arthrobranchs on all but the first and last, and pleurobranchs on the last four.

(15) The *thoracic segments* which bear the legs with distinct sterna, which are not very broad, but grow broader from before backwards, and are all fused except the last[2].

(16) The first pair of *abdominal limbs* unbranched. Those of the second to fifth segments with two fairly broad branches, the inner of which bears an *appendix interna* (Fig. 126 *c*). The last pair about as long as the telson, with broadly oval branches, across the outer of which is a suture.

The internal anatomy of the various groups is not yet well enough known to allow of general statements being made about it.

The animal was hatched in the Zoea stage, with a segmented abdomen but no limbs behind the third maxilliped, and passed through a *Mysis* stage with exopodites on all the legs.

The descendants of the crustacean which we have thus reconstructed fall into two sets, one comprising the Eryonidea, Scyllaridea, and Nephropsidea, in which the abdomen is strong and well-armoured, stretched out unprotected, and used as a swimming organ by means of its tail-fin, and the other containing the rest of the groups, in which it has for some reason become a burden and a source of danger to be protected and kept from exposure, even though it be still shaped and used for swimming. The first of these sets is on a lower and more primitive grade of organisation than the second. This is shown (1) by the abdomen, with its stout armour, overlapping terga and pleura, strong processes to clip the carapace on the first segment, broad tail-fin, and, in the Eryonidea and Scyllaridea, *appendices internae*. To this form of abdomen, which is always carried at length, I shall restrict the term "macrurous." (2) by the legs, which in the Eryonidea and Nephropsidea are chelate in the first three pairs and have seven joints (except for the first pair of the Nephropsidea) whereas in all other Reptantia they have only six, owing to the fusion of the basipodite and ischiopodite, (3) by the large number of the gills, (4) by the slender third maxillipeds with their long flagella directed forwards, (5) by the broad antennal scale of the Eryonidea and Nephropsidea. Of course some of the foregoing characters are found in primitive members of other groups, but they stamp this set of groups as a whole. Of the three macrurous groups, the Eryonidea and Scyllaridea are more nearly allied together than either of them is to the Nephropsidea. They have both lost, or much reduced, their rostrum (except *Palinurellus*), reduced the inner lobes of the second maxilla, and fused their carapace at the sides with the epistome, but they have kept the *appendices internae*. Their body

[1] This character, though it is most prominent in the Anomala and Thalassinidea and the lower Crabs, is seen to some extent even in the more primitive groups, as the Palinuridae and Potamobiidae.

[2] A primitive feature, found not only in Boas' Anomala but also in the Thalassinidea, Potamobiidae and Parastacidae and in the prawn *Stenopus*. In *Penaeus* the anterior sterna are free, but the last two are joined by secondary thickenings in the membrane between them.

shows a tendency to be flattened. The Nephropsidea differ from them in all these respects. Between the Eryonidea and the Scyllaridea the most striking difference lies in the fact that in the former all the legs are chelate and in the latter none are so. The Eryonidea are the more primitive in keeping the antennal scale, the joint between the ischiopodite and meropodite, and the chelae on the first three legs.

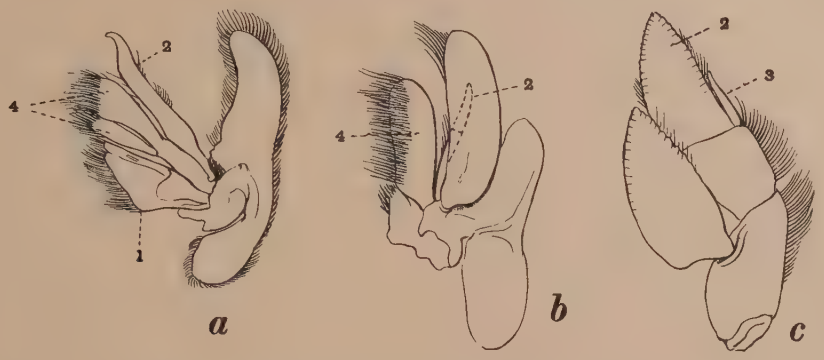


Fig. 126. Limbs of *Axius acanthus*; *a*. second maxilla, *b*. first maxilliped, *c*. abdominal limb of the third pair. 1. gnathobase or first lobe of coxopodite, 2. endopodite, 3. *appendix interna*, 4. lobes of basipodite.

In considering the second set of groups, we have first to settle whether to look upon them as of common descent and treat them as a whole, or whether we must find a separate point of origin for each of them from among the Macrura. Now it may be allowed at the outset that there is but one character that every member of them shares with the rest. In the macrurous groups the first three pairs of legs are all alike, adapted either to seizing or to crawling—chelate, that is, or simple. But in the modified groups we are now dealing with the third pair is never adapted to the same end as the first. In the overwhelming majority the first pair are chelate or subchelate[1] and the third used for walking, and in the Hippidae, where the first are simple and straight, the third are hooked and flattened for burrowing or swimming. Nor is this point an unimportant one, for the likeness of the first three legs is a heritage from the penaeid prawns, and as such is of considerable value. Moreover it is possible to find a number of characters which, while they are not seen in every member of the non-macrurous groups, are yet common in each of them, and do not occur elsewhere. These are: (1) a large gnathobase, or inner coxopoditic lobe, on the second maxilla (Fig. 126 *a*), (2) the shape of the first maxilliped, which has a broad but shallow basipoditic lobe, whose inner margin is in the same line with that of the coxopodite[2], and a broad basal half to the exopodite (Fig. 126 *b*), (3) the flagella of the maxillipeds turned inwards and curved forwards at their ends, (4) reduction in various ways of the abdomen, (5) the presence of backward prolongations of the longitudinal lines of the carapace[3]. Since, however, numbers (3) to (5) are less strongly marked in the more primitive forms of some of the groups, it is doubtful whether much stress can be laid upon them.

Taking it for granted, then, that the non-macrurous Decapods had a common, if remote, ancestor, it remains to be seen where that ancestor must be placed with regard to the

[1] *Gebicula* seems at first sight to be an exception to this, but there is on the propodite a strong tooth near the end which seems almost certain to be used in the same way as the "thumb" of the allied *Upogebia*.

[2] Found also in at least one species of *Nephropsis*.

[3] See above, footnote to p. 691.

macrurous groups. For this purpose we must add to the list above certain other characters which, either from their own primitive character or because they are found in many of the primitive members of the groups we are trying to place, may be attributed to the forebears of these groups: (6) a large gill-formula, including all the gills of the ancestral reptant[1], (7) a small thorn-like antennal scale[2], (8) the last pair of legs not only on a free sternum[3] as in the Potamobiidae and Parastacidae, and slightly twisted at the end as in most macrurous Reptantia, but distinctly smaller than the fourth pair, removed from them, and carried more dorsally, (9) a rather short and broad *rostrum*, (10) *appendices internae* on abdominal limbs[3], (11) a transverse suture on the telson[4].

Numbers (6) to (9) of these remove the crustaceans in which they are found from the neighbourhood of the Eryonidea and Scyllaridea, since they are primitive features that the latter have lost. Numbers (6) and (10) remove them for the same reason from the Nephropsidea, to which, nevertheless, they are more akin than to the other macrurous groups. The jaws and the last thoracic sternum, but not the structure of the gills or the grooves on the carapace, are more like those of the Potamobiidae than those of the Nephropsidae.

Assuming, as above, a common descent for the Crabs, Anomala and Thalassinidea, we must at the same time admit that they very early divided into two widely separated branches, one containing the Crabs and the other the remaining groups. The characters by which this separation is shown are the following: (1) The great reduction of the abdomen in the Crabs. This is entirely independent of similar developments in the higher Anomala, for the more primitive of the Paguridea and Thalassinidea, though they share the tendency, common to the whole assemblage of families under discussion, to shelter and protect their abdomen, have as yet been hardly more affected by it than, say, the burrowing genera of Nephropsidea, which are quite macrurous, while the primitive Galatheidea are little better in this respect. Moreover, in the Crabs, the reduction has gone so far that the abdomen, having lost its sixth pair of limbs (except for doubtful, unbranched vestiges in some Dromiidea), is now fitted for, and shows traces of, no other function than those connected with reproduction, while in the Anomala and Thalassinidea, though some of its macrurous features are always reduced, it has kept the sixth pair of limbs and nearly always uses them either for swimming or for holding on a shell. The Lithodinea alone form an exception to this statement, but in them the asymmetry of the abdomen clearly recalls its former use, as in the Hermit crabs, to hold on a shell. These two types of abdomen—of which one does, while the other does not, show traces of adaptation to some other function than that of reproduction—I propose to call the "brachyurous" and "anomurous" respectively. (2) The carapace, which in the Anomala and Thalassinidea remains free, is in the Crabs fused with the epistome both at the sides and (except in *Homolodromia*) in the middle, under the front. (3) The antennal scale, which in many Anomala and Thalassinidea remains and is moveable, is never found in that condition in the Crabs. (4) The endopodite of the first maxilliped is broad and has nearly always an outer angle in the Crabs (see above, p. 425, fig. 110), but has not this shape in the Anomala and Thalassinidea, though some Hippidea approach it. (5) There are never *appendices internae* on the abdominal limbs of the Crabs, whereas these structures are present in most Thalassinidea and some Anomala. (6) The third pair of maxillipeds of the Crabs are

[1] See above, p. 692. This is shown by *Jaxea*, *Homolodromia*, etc.

[2] Among the Crabs found only in *Homolodromia*, where it is fused to the stalk.

[3] Not found in the Crabs.

[4] Found in certain Galatheidea and Paguridea.

usually broad, forming a cover to the mouth, whereas those of the Thalassinidea and Anomala are only exceptionally so. These characters, however, are in themselves hardly enough to negative the supposition that the Crabs have originated from one of the other non-macrurous groups. What does make it impossible to derive them from the Anomala is the presence in the primitive crab *Homolodromia* of podobranchs on some of the legs, while an origin from the Thalassinidea is equally untenable on account of the less primitive condition of the grooves of the carapace and the reduction of the endopodite and flagellum of the first maxilliped in the latter group.

We are now left with the Thalassinidea and the three divisions of the Anomala still unaccounted for. Among these there can be no question that the Thalassinidea are, as a whole, the most primitive. Their straight symmetrical abdomen, with well-developed biramous limbs on all the segments except the first, and the sixth pair broad and flat in all but *Thalassina*, the presence in most of *appendices internae*, and in some of good pleura, the simple legs of the fourth pair and sometimes also of the fifth, the *rostrum* usually well-developed, the moveable antennal scale seldom wholly lost, and the large gill-formulae of many genera, extending from the second maxilliped to the fourth leg, with mastigobranchs, podobranchs, arthrobranchs and sometimes pleurobranchs—all these point to the same conclusion. Nor can there be any doubt that the Paguridea and the Thalassinidea are closely akin and have branched off from the same not very remote ancestor. The only differences between the Axiidae and the primitive Pagurids with symmetrical abdomen such as *Pylocheles* are the presence of a pleurobranch on the last leg, a suture across the telson in some species (which is never found in Thalassinidea), better developed eyes[1], the loss of epipodites on the legs, a reduced rostrum, subchelate legs of the fourth pair, and the branches of the last pair of abdominal limbs narrow and not adapted for swimming. The first three of these features, being primitive, show that the Paguridea are not to be derived from any of the existing Thalassinidea and the remainder make it equally impossible to derive the latter group from the former. The two meet at a point below our present horizon.

The Galatheidea join the stem from which the last two groups arise before its bifurcation, that is, they are less closely akin to either of these than the latter are to one another. The fact that they may have epipodites on some of the legs, and the more primitive shape of the rostrum and sixth pair of abdominal appendages make it impossible to place their ancestor within the present limits of the Paguridea. The suture on the telson and the pleurobranch on the last leg remove it also from the Thalassinidea. And the general shape of the body, depressed, with broad flat abdomen carrying long pleura and bent under the thorax, is so different from the compressed body, with straight abdomen, of the primitive Paguridea and Thalassinidea that there can be little doubt that the ancestral Galatheid left the non-macrurous stock, after the Crabs indeed, but before it gave rise to the Thalassinids or Hermit-crabs. As for the *linea anomurica*, this is found not only in the Galatheidea and Paguridea but also very distinctly in *Callianassa novaebritanniae*, and it is curious to notice that it is wanting in the primitive Pagurids such as *Pylocheles*, and most Thalassinids as in *Axius*, and that in the Galatheid *Aeglea*, which is also primitive in many respects, the hinder part is again wanting. Thus it would seem as though this line appeared only in the higher and more typical forms of each group. The Hippidea present a very difficult problem. On

[1] Such species as *Axiopsis clypeatus*, however, have the eyes well developed, though not so large as those of the Paguridea.

the whole, however, their general shape of body, with a bent abdomen carrying good pleura, subcylindrical or depressed cephalothorax, and fourth pair of legs like the third rather than the fifth, shows a nearer kinship to the Galatheidea than to any of the other groups, and in the absence of any evidence to the contrary this judgment must stand. As for their likeness to the Raninidae among the Crabs, an admission that this indicated relationship would lead to great difficulties, as for instance that the Raninidae must either be removed from the closely related Oxystomes or the latter be supposed to be derived by modification from the highly specialised Hippidea—in itself a very unlikely speculation.

Each of the above groups has its peculiar habits and habitat. The Galatheidea hide under stones or dwell in weed. The Thalassinidea generally make burrows, but the more primitive genera among them show a tendency to shelter in weed or sponges. The Paguridea (except Lithodinea) place their abdomen in the hollow of some foreign body, which is usually a gastropod shell, but in the primitive genera may be a stone or a sponge. The Hippidea bury themselves in the sand. Of these habits, that of the Galatheidea is the least specialised and could easily have given rise to the others.

We are now in a position to sum up in the form of a tree the results reached in this and former articles (Pl. XLVIII.). When this is done two facts of importance appear. First that the proper place of the Thalassinidea is in the midst of the anomurous groups, and that they must no longer be classed with the Macrura, and secondly that, when this change is made, the Anomura, like the Brachyura, become a true, monophyletic group. Thus the reptant decapods fall into three divisions, Brachyura, Anomura[1] and Macrura. To the subject of the taxonomic value of these groups and their relation to the natant families I hope to return later on. For the present they may be called suborders[2].

The following keys give more precisely the classification of the groups discussed above:

Key to the reptant suborders of the Decapoda.

I. 3rd pair of legs like the first, either chelate or simple and subcylindrical. Abdomen macrurous (straight, symmetrical, well armoured, with good pleura and strong, broad tail-fin, a lobe on the first segment clipping the carapace). Gnathobase of 2nd maxilla narrow. Basipoditic lobe of 1st maxilliped usually deep. Exopodites of maxillipeds with lash directed forwards. Gills numerous. [Last thoracic segment with legs not differing greatly from the rest and sternum rarely free.] *Macrura.*

II. 3rd pair of legs unlike the first[3], never chelate. Abdomen rarely macrurous. Gnathobase of 2nd maxilla typically broad. Basipoditic lobe of 1st maxilliped broad but shallow, its inner edge in a line with that of the coxopodite. Exopodites of maxillipeds with lash, when present, nearly always bent inwards. Gills usually few. Last thoracic segment with limbs often differing greatly from the rest and sternum free or not.

1. Carapace not fused with epistome. Last thoracic sternum free, its legs differing always clearly in size and position and nearly always in shape from the third pair. Abdomen anomurous (reduced in some of its features but showing clear traces of some other function than that of reproduction and almost always carrying biramous limbs on the 6th segment) or, rarely,

[1] Unlike Boas' term "Anomala," the name "Anomura" has had very different meanings in the pages of different writers. This fact allows it to be used here with a denotation which it has not had before.

[2] The Brachyura is ranked lower on p. 427.

[3] See footnote to p. 693.

macrurous. A moveable antennal scale often present. Third pair of maxillipeds usually narrow. *Anomura.*

2. Carapace fused with epistome at the sides and nearly always in the middle. Last thoracic sternum fused with the rest, its legs often like the others. Abdomen brachyurous (small, straight, symmetrical, bent under the thorax, showing no traces of any other function than that of reproduction, and without biramous limbs on the 6th segment). Never a moveable antennal scale. 3rd pair of maxillipeds usually narrow. *Brachyura*[1].

Key to the tribes of the reptant Macrura.

I. Carapace fused at the sides to the epistome. Rostrum small or wanting (except *Palinurellus*). Inner lobes of 2nd maxillae and 1st maxillipeds reduced. An *appendix interna* on some of the abdominal limbs, at least in the female, but the exopodite of the last pair without sharp suture. Body often depressed.

1. Carapace gripped by first abdominal segment alone. First joint of antenna not fused with epistome; a scale present on this limb. All the legs, except sometimes the last pair, chelate; the first longer than the rest. Unbranched limbs on the first abdominal segment. Tail-fin not softer behind than before, without sutures. Telson pointed. *Eryonidea.*

2. Carapace gripped between a lobe on the 1st abdominal segment and a knob on the side of the last thoracic segment. First joint of antenna fused with epistome; no scale on this limb. None of the legs much longer than the rest or, except sometimes the first pair, chelate. No limbs on the 1st abdominal segment. Tail-fin divided by indistinct sutures into a soft hinder half and a harder front half. Telson roughly squared behind. *Scyllaridea*[2].

II. Carapace free from the epistome. Rostrum of good size. Inner lobes of 2nd maxillae and 1st maxillipeds not reduced. No *appendix interna*, but the exopodite of the last abdominal limb divided by a suture. Body subcylindrical. [Carapace gripped by first abdominal segment only. 1st joint of antenna free. A scale present. First three legs chelate, first pair the longest. Telson firm, squared, often sutured.] *Nephropsidea.*

Key to the tribes of the Anomura.

I. End-joints in 2nd to 4th legs curved and flattened. First pair styliform or subchelate. [Tail-fin not adapted for swimming. Abdomen bent under thorax. Rostrum small or wanting. 3rd pair of maxillipeds carry no mastigobranchs.] *Hippidea*[2].

II. End-joints in 2nd to 4th legs not curved and flattened. First pair not styliform, rarely subchelate.

1. 6th abdominal limb adapted for swimming (except in *Thalassina* where it is styliform. Pleura usually well developed. Abdomen symmetrical.

a. Body depressed. A pleurobranch to the last leg. Often a transverse suture on the telson. Abdomen more or less bent under the thorax. *Galatheidea.*

b. Body compressed. No pleurobranch to the last leg. No transverse suture on the telson. Abdomen straight. *Thalassinidea*[3].

[1] For a classification of the Crabs, with keys, see above, vol. I. pp. 426 ff.

[2] Keys to the families of these groups will be given in the articles which deal with them.

[3] For a classification of this group, with keys, see *Ann. Mag. N. H.* (7), XII.

2. 6th abdominal limb, when present, has the branches neither broad nor styliform but adapted for holding the body into hollow objects. Pleura very rare. Abdomen nearly always asymmetrical and either soft and twisted, or bent under the thorax. *Paguridea.*

Key to the subtribes of the Paguridea.

I. Abdomen straight or twisted. Carapace firm and more or less compressed in the fore part, soft in the hinder part. Fourth pair of legs unlike the third. Rostrum almost or quite wanting. *Pagurinea.*

II. Abdomen bent under the thorax. Body crab-like. Carapace firm all over. Fourth pair of legs like the third. Rostrum spiniform. *Lithodinea.*

EXPLANATION OF PLATE XLVII.

Fig. 1. *Huenia proteus*, male of triangular shape; *a.* whole animal, *b.* part of the fine graving of the back, greatly magnified.

Fig. 2. *Huenia proteus*, female.

Fig. 3. *Naxioides spinigera*, male; *a.* whole animal, *b.* outside of hand, *c.* hooked hairs of two different shapes.

Fig. 4. *Halimus espinosus*, male; *a.* whole animal, *b.* outside of hand, *c.* end-joint of a walking leg, *d.* hooked hairs.

Fig. 5. *Lambrus* (*Rhinolambrus*) *turriger*; *a.* whole animal, *b.* part of under side to show grooves for breathing stream. 1. endopodite of 3rd maxilliped, 2. exopodite of the same, 3. base of epipodite of the same, covering opening to gill-chamber, 4. ridge on under side of body (not outer edge), 5. outer end of inner groove, 6. outer end of outer groove, 7. inner groove, 8. fore edge of mouth.

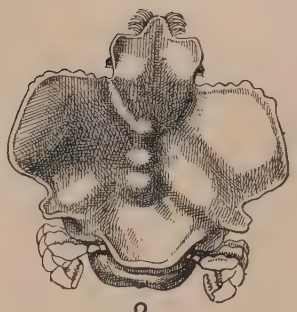
Fig. 6. *Lambrus* (*Aulacolambrus*) *sculptus*; part of inner groove corresponding to (7) in fig. 5, showing the covering of hairs.

4c

4d

4b

4a



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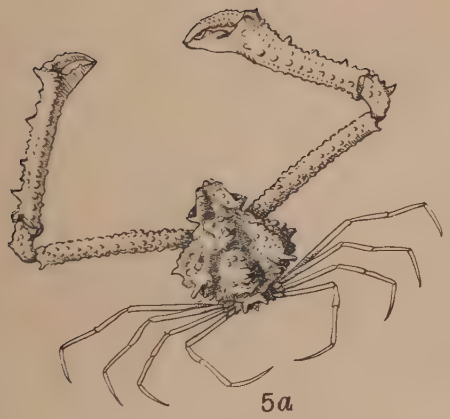
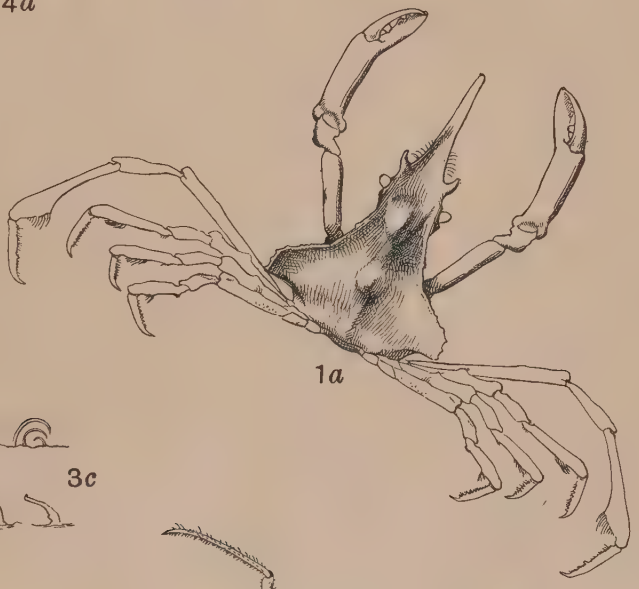
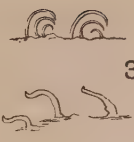


5a

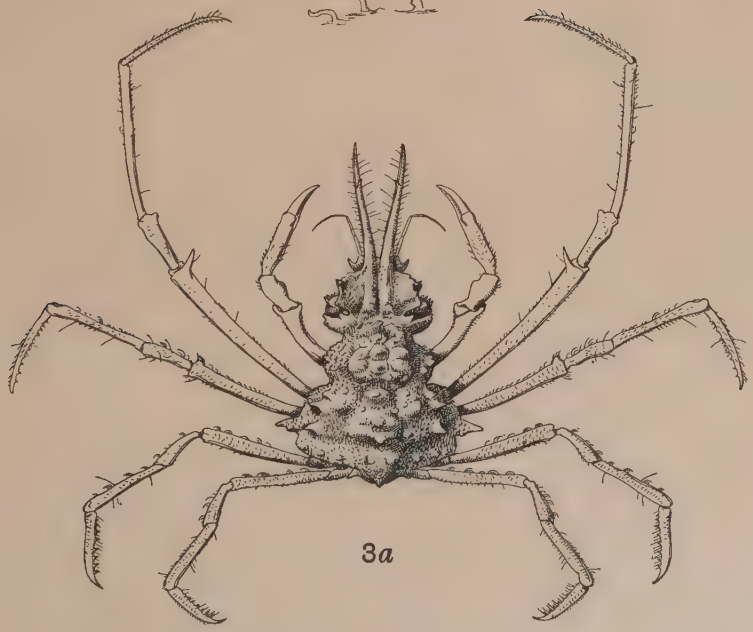
1b



1a

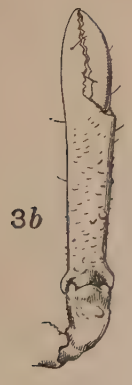


3c

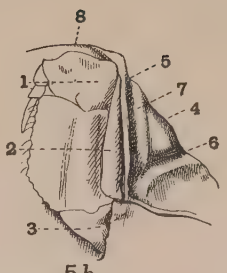


3a

6



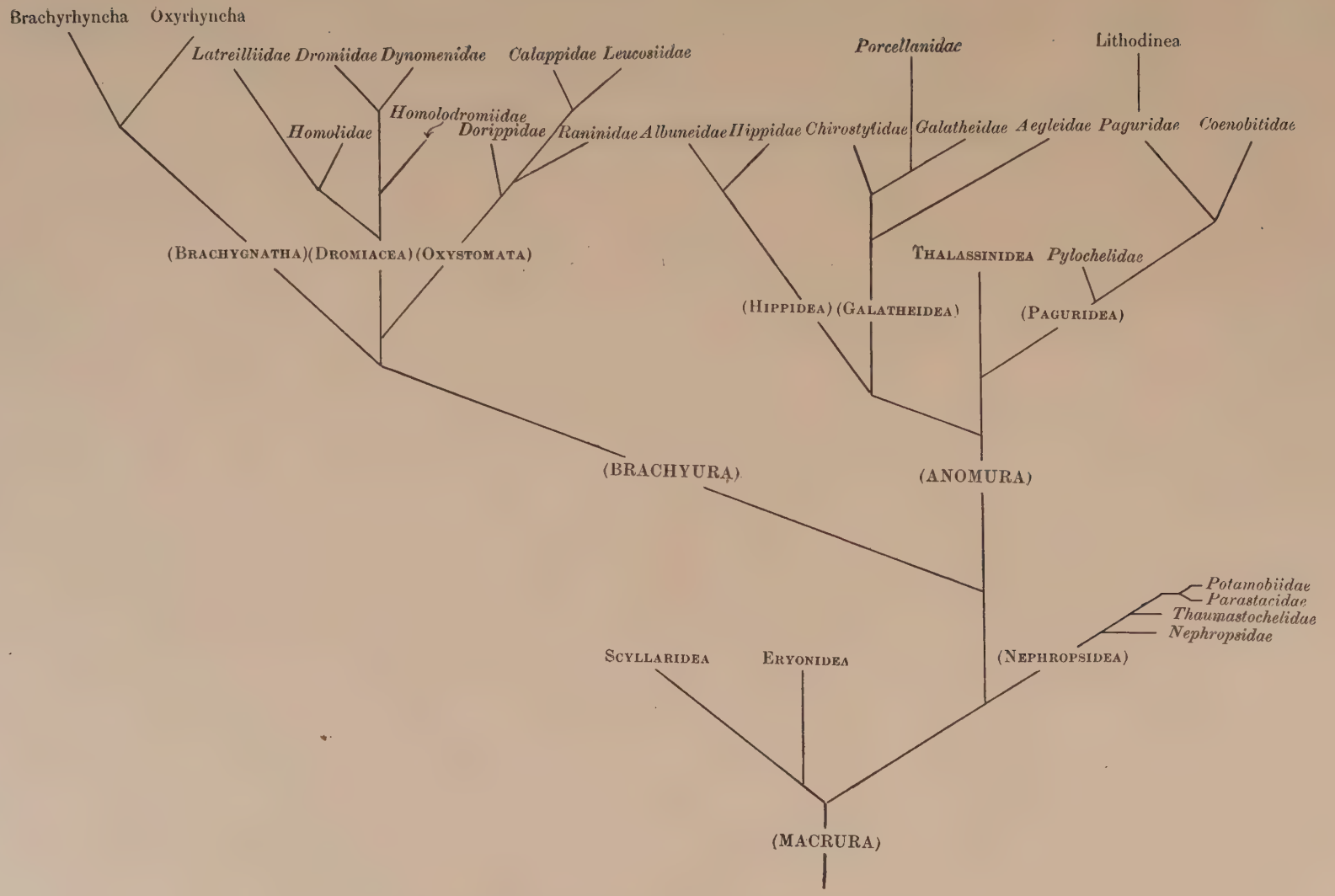
3b



5b

E. W. del.

BORRADAILE——OXYRHYNCHA.



GENEALOGICAL TREE OF THE REPTANT DECAPODA.

The groups in the first row have all reached the same grade of organisation as the Crabs. Those in the second row are in the Anomalous grade, the third row in the Thalassinid grade, and all below in the Macrurous grade. (The Brachyrhyncha and Oxyrhyncha should be in the first row with the Latreilliidae, etc.)

MARINE CRUSTACEANS.

XII. ISOPODA, WITH DESCRIPTION OF A NEW GENUS.

By the Rev. T. R. R. Stebbing, M.A., F.R.S., Sec. L.S.

(With Plates XLIX.—LIII.)

This small collection of Isopoda was entrusted to me for identification and description by my friend Mr L. A. Borradaile, M.A., F.Z.S., of Selwyn College, Cambridge. Of the fourteen species contained in it eight appear to be new, and for some of those which are not new the collection has supplied information likely to be of service. Especially attention may be called to the opinion expressed about Dana's genus *Corallana*, that opinion, if correct, involving the transfer of several species from Dana's genus to a new one named *Excorallana*.

FLABELLIFERA.

Flabellifera, 1882, Sars, *Forh. Selsk. Christian.*, No. 18, p. 15; 1893, Stebbing, *History of Crustacea*, p. 330; 1897, Sars, *Crustacea of Norway*, Vol. II. Pt. 3, p. 43; 1901, Harriet Richardson, *Proc. U.S. Mus.* Vol. XXIII. p. 505.

Sars observes that 'the tribe includes six very distinct families, viz. *Anthuridae, Gnathiidae, Cymothoidae, Serolidae, Sphaeromidae,* and *Limnoriidae*; but of these the third has generally been again subdivided into six families, viz. *Aegidae, Cirolanidae, Corallanidae, Alcironidae, Barybrotidae,* and *Cymothoidae,* thereby increasing the number of families to no less than eleven in all.' That the existing classification requires to be slightly modified will be argued in the following pages. The number of the families, however, will not be altered, and species representing six of them will have to be considered.

Fam. **Anthuridae.**

In Willey's *Zoological Results*, Part 5, pp. 618—620, 1900, I have rather fully discussed the history of this family from its institution by Leach in 1814 to the end of the nineteenth century, and am unwilling therefore to repeat what has been so recently published.

The resemblance that often exists between some at least of the limbs in species of this family and those in the Cryptoniscus-stage of the *Epicaridea* is perhaps not unworthy of remark.

A single specimen, about 6 mm. long, of a species apparently belonging to *Anthura* or *Cyathura*, was 'found on the back of a teat-fish at Minikoi.' As the specimen had gone dry, it seemed expedient to wait for further material before attempting to give this form its place in classification.

Gen. *Calathura*, Norman and Stebbing.

Calathura, 1886, Norman and Stebbing, *Trans. Zool. Soc. London*, Vol. XII. Pt. 4, p. 122; 1893, Stebbing, *History of Crustacea*, p. 332; 1897, Sars, *Crustacea of Norway*, Vol. II. Pt. 3, p. 44; 1901, H. Richardson, *Proc. U.S. Mus.* Vol. XXIII. p. 509; 1901, Axel Ohlin, *Bihang till K. Svenska Vet.-Akad. Handlingar*, Vol. XXVI. Pt. 4, p. 17.

The genus was instituted to receive *Anthura brachiata*, Stimpson, of which *Paranthura norvegica*, Sars, and *Paranthura arctica*, Heller, were considered to be synonyms. Sars in 1897 maintains the distinctness of his *C. norvegica*, which Ohlin in 1901 refuses to admit. The *C. affinis* of Bonnier belongs, as I have earlier argued, rather to *Paranthura* or *Leptanthura*. In 1901 Miss Richardson added a new species, *C. crenulata*, from the Bahamas and Yucatan. If we admit the presence of eyes in *C. brachiata*, as affirmed by Harger and Heller and Sars, but denied by Ohlin, the species of the genus may be distinguished as follows:—

1	Eyes wanting.	1. *C. norvegica*, Sars.
	Eyes present.—2.	
2	Eyes feebly developed, with pigment white.	2. *C. brachiata* (Stimpson).
	Eyes well developed, with pigment black.—3.	
3	Head only half as long as first peraeon-segment.	3. *C. crenulata*, Richardson.
	Head much longer than half the first peraeon-segment.	4. *C. borradailei*, n. sp.

It is not altogether improbable that the second species which Haswell referred to his genus *Haliophasma*, namely *H. maculatum*, may when more fully described have to be transferred from that genus to *Calathura*.

1. *Calathura borradailei*, n. sp. Pl. XLIX A.

Head with distinct rostral point, the lateral angles strongly produced. Segments of peraeon stout, apparently not carinate at the sides, the first as usual closely attached to the head, and the second distally narrowed, the seventh segment much the shortest. Segments of the pleon all distinct. The long narrowly oval telson has the apex fringed with setae nearly as long as itself, with scarcely perceptible crenulation. There is no appearance in it of 'statocysts' such as those described in *Anthura gracilis* by A. Thienemann (*Zool. Anzeiger*, Vol. XXVI. May 8, 1903).

The eyes are black, subtriangular, with the apex upward, situated near the antero-lateral angles of the head, which are rounded, not acute as they appear in a dorsal view.

The first antennae have the first joint of the peduncle longer than the other two combined, and a flagellum of twenty-one joints, the first seven stout, the rest filiform. The second antennae have a long second joint between two shorter joints, the fourth much longer than the third, and the fifth as long as the second. The flagellum, fringed with short setae, is composed of twenty-two joints.

The horny-pointed mandibles have the third joint of the palps the longest and probably armed with spines, though they were not actually seen. The second maxillae are evidently present, very slender, armed with long setae, and joining with the lower lip and maxillipeds to form a tube. In the maxillipeds it is difficult to determine whether that which Sars claims as the very short first joint of the palp may not be the base of the large joint

which he makes the second. Should that be so, the palp in *Calathura* will be not three-jointed, but, in accordance with Harger's view, two-jointed.

The first gnathopods are robust, but so provided with lobes and grooves that the various joints may be compactly folded together. As usual the fourth joint is broad, and the fifth very small, resting on the boss which projects at the base of the palm. The sixth joint is massive, with the convex front margin longer than the hinder one, which differs from what is found in the other species by forming a convex instead of a concave palm. This is bordered with spinules and flanked with setae projecting from the surface on either side. The finger is long and curved.

The second gnathopods were mutilated, wanting the last three joints, but they were evidently in agreement with the first peraeopods, which have the fifth joint very small, triangular, underriding the narrowly oblong oval sixth joint. The latter is fringed along the hind margin with setae and six spines, which are followed near the junction with the finger by a series of trifurcate spines. The finger has some little stiff hairs along the inner margin and many setules on the convex outer margin. It ends in a spine and a small nail.

The remaining peraeopods are more slender, and have the fifth joint attached end to end to the neighbouring joints, attaining its greatest length in the fourth pair. The second and third pairs are the shortest. In all the finger is shorter than the sixth joint.

The pleopods have the inner branch narrowly oblong. The male appendage of the second pair reaches beyond the branches and is slightly widened at the apex.

The uropods appear nearly to resemble those of *C. crenulata*, but to be fringed with much longer setae. The upper ramus, however, though elongate, does not reach beyond the basal joint of the lower one. The terminal joint of the latter is only a third as long as the basal. There seems to be a short peduncle distinct from the rami. The specimen in spirit had a few brown spots and stellate markings on a light ground.

Length of the specimen in strongly curved position 6 mm.; actual length about 10 mm.

Locality. A single specimen, male, taken at 23 fathoms depth, on hard ground, in Fadifolu Atoll.

The specific name is chosen out of respect to Mr L. A. Borradaile, the zealous carcinologist, through whom the present collection of isopods was entrusted to me.

Fam. **Cirolanidae.**

For the bibliography of this family reference may be made to Willey's *Zoological Results*, Part 5, p. 628, 1900, and *South African Crustacea*, Part 2, p. 49, 1902.

2. *Cirolana sulcaticauda*, n. sp. Pl. XLIX B.

This small species belongs to the group in which the angles of the fifth pleon segment are enclosed by those of the fourth, and in which the hind limbs are not adorned with long setae. By the longitudinal medio-dorsal furrow of the telsonic segment its close approximation to *C. sulcata*, Hansen, is established. In other respects the pleon clearly separates the present from the South African species.

The first segment of the peraeon is much the longest, the last three are somewhat transversely rugose, with a line of tubercles adjacent to the hind margin. The first two segments

of the pleon are short and smooth; the following three have each three conspicuous tubercles, of which the middle one is the largest. In a lateral view the large median tubercle of the fifth segment has the appearance of a great boss overhanging the telsonic segment. The latter, though like *C. sulcata* furrowed down the centre between two tuberculate carinae, differs by the greater parallelism of these keels which in the other species bend towards one another at each extremity. Here the telson has eight spines at the apex instead of six; its convergent sides are ridged, but not notched near the base. The setae are plumose.

The eyes are dark, of moderate size. The first antennae have the peduncle clearly three-jointed, especially on the under side; in the short six-jointed flagellum the first joint is considerably the longest. The second antennae have a peduncle as long as the first antennae, its first three joints subequally short, the fifth a little longer than the fourth; the thirteen-jointed flagellum rather longer than the peduncle.

The frontal lamina has its apex rounded, the sides converging slightly to the short wide epistome. The upper lip has the lower margin slightly concave. The spines of the mandibular palp are short, finely denticulate. The inner plate of the first maxillae carries three short hirsute setae. The plates on the second joint of the maxillipeds are held together by two pairs of hooked spines; the fourth joint is short, the seventh narrow.

The first gnathopods have five stumpy spines on the hind border of the fourth joint; the fifth scarcely asserts its existence except by a blunt projection of its hind margin; the sixth has two blunt spines; the finger is tolerably stout with a well pronounced nail.

In the following limbs the fifth joint successively gains in prominence, till in the fifth peraeopods it is subequal to the fourth or sixth. In the hind limbs the fourth and fifth joints carry some long spines which are finely serrate.

In the second pleopods the male appendage is rather longer than the ramus to which it is attached. The rami of the uropods are fringed with spines and plumose setae, the setae at the apical notched angles being the longest. The inner ramus is very broad, reaching beyond the outer one and the telson.

The specimen was 5 mm. long, with a breadth of about 2 mm.

Locality. The single specimen, a male, was taken at Hulule, along with some of Dana's *C. latistylis.*

The specific name is chosen to call attention to the relationship between this and the species with which it has been compared.

3. *Cirolana latistylis,* Dana.

Cirolana latistylis, 1853, Dana, *U.S. Expl. Exp.*, Vol. XIII. p. 772, Pl. 51, fig. 6 *a—c*; 1884, Miers, *Report Zool. H.M.S. Alert*, pp. 303, 304; 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Part 3, p. 356; 1897, Whitelegge, *Mem. Australian Museum*, Vol. III. Pt. 2, p. 149; 1900, Borradaile, *Proc. Zool. Soc. London*, p. 797.

'Body smooth, naked, but slightly interrupted at base of abdomen. Head transverse, anteriorly rounded, not longer than next segment. Abdomen six-jointed; first segment nearly concealed under the thorax; caudal segment subtriangular, a little oblong, broadly rounded at extremity and crenulate, and ornate with spinules and shortish hairs. Caudal appendages not reaching beyond line of abdomen, inner lamella broadly subovate, having crenulations, spinules, and hairs like the caudal segment; the hairs not half as long as the lamella; outer lamella

considerably the shorter and half narrower.' This description given by Dana agrees excellently with our specimens, except that in them the inner ramus of the uropods extends slightly beyond the telsonic segment, and the outer ramus is as in Dana's own figure a little over half as broad as the inner. The hind margin of the head is concave. The second and third segments of the peraeon are rather shorter than the rest. The eyes are large, black, wide apart, so that their size is more apparent in a ventral than a dorsal view.

The upper antennae are separated only by the meeting apices of the head's underfolding triangular rostral point and the pentagonal frontal lamina. The first two joints of the peduncle are only faintly separated, and the third joint is subequal in length to the two combined; the first joint of the nine-jointed flagellum is much shorter than the second, the whole reaching a little beyond the peduncle of the second antennae. In these the first three joints are short, the fifth slightly longer than the fourth, the elongate flagellum in the specimen examined consisting of 21 joints.

The mouth-organs are characteristic of the genus.

The limbs are of the same general type as in the preceding species, the sixth joint in the first gnathopod is considerably broader than in the two following pairs of legs. Dana observes that 'the fourth joint of the third pair is a little shorter than either the third or fifth pairs, and longer than the tarsus.' In our notation this should read that the fifth joint is a little shorter than the fourth or sixth, and longer (but only a little longer) than the seventh.

In the telsonic segment there are four spines on each side of the bifid apical point.

Colour (in spirit) light, with brown speckling of very variable density.

Length 5 mm. by a breadth of 2 mm. or a little over. Dana gives the length as three lines, which would be something more than 6 mm.

Locality. North Malé Atoll, 35 fathoms, hard sand; Hulule; Suvadiva Atoll, 44 fathoms, hard muddy bottom; Kolumadulu Atoll, 38 fathoms, mud and weed.

Dana obtained the species from Straits of Balabac, north of Borneo, Whitelegge from 'sponges in sandy pools' at Funafuti Atoll, Borradaile also from Funafuti, 'three examples found on weed in the lagoon, one dredged in the lagoon in 15—25 fathoms of water.'

A specimen from Minikoi, noted as an 'Isopod living in tentacles of large tubicolous worm (Polychaeta 4),' measured 5 mm. in length, by only 1·25 mm. in breadth. But after drawing and dissecting it I could find no character but the narrowness to separate it from Dana's species. It was a female, but not carrying eggs or young. The marsupial plates have the hind margin cut into a fringe.

Fam. **Corallanidae.**

Corallanidae (part), 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Pt. 3, p. 280; *Alcironidae*, 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Pt. 3, pp. 285, 312, 390; 1893, *Corallanidae* (part), Stebbing, *History of Crustacea*, p. 345; *Alcironidae*, 1893, Stebbing, *History of Crustacea*, p. 346; *Corallanidae* (part), 1901, Richardson, *Proc. U.S. Mus.*, Vol. xxiii. p. 517; *Alcironidae*, 1901, Richardson, *Proc. U.S. Mus.*, Vol. xxiii. p. 519.

In 1895 Dr H. J. Hansen reduced these two families to the rank of subfamilies. Whatever the systematic dignity allowed them, they must, I think, be united. Were the Alcironidae independent that group would more properly take its name from *Tachaea* of Schiödte and Meinert,

that genus being older than *Alcirona* and *Lanocira*, both instituted by Hansen in 1890 to be its companions. At the same date that author beautifully illustrated and described with his accustomed clearness seven species from western waters, which he assigned to Dana's genus *Corallana*. Miss Harriet Richardson in 1901 added to this set an eighth species from Florida. Hansen had further noted eleven species earlier than his own as with more or less probability belonging to the same genus or at least to the same family. One of them, however, is *Corallana hirticauda*, the single species on which Dana founded his genus. Although the description does not satisfy all modern requirements it enables the species when obtained to be recognized, and the conclusion cannot be escaped that its generic character is distinct from that of the species assigned to *Corallana* by Hansen and Richardson. These, accordingly, I have referred to a separate genus *Excorallana*, distinguished by the great length of the apical tooth of the mandibles, the bifid termination of the second maxillae, and the elongate antepenultimate joint of the maxillipeds. The true *Corallana* agrees with *Tachaea*, *Alcirona*, and *Lanocira*, in not having the point of the mandible very strongly produced, in having the apex of the second maxillae simple, and in having the antepenultimate joint of the maxillipeds not longer than broad. Hansen's definition of the *Alcironidae* appears very well to suit the *Corallanidae*, taken to include the above-named four genera, but excluding *Excorallana*, which will become the representative of a family *Excorallanidae*.

Gen. *Corallana*, Dana.

Corallana, 1853, Dana, *U.S. Expl. Exp.*, Vol. XIII. pp. 748, 773; 1879, Schiödte and Meinert, *Naturhist. Tidsskrift*, Ser. 3, Vol. XII. p. 286.

Schiödte and Meinert, in their treatise *De Cirolanis Aegas simulantibus*, group together *Barybrotes*, *Tachaea*, new genera, with Dana's *Corallana*. The first of these was placed by Hansen in a separate family, *Barybrotidae*. To the third the joint authors assigned six species, one of them being Heller's *Aega basalis* from the Nicobar Islands, the remaining five (of which four were new) having all been found at Ubay in the Philippines. Two of their species they distinguished as *Corallana hirticauda*, Dana, and *Corallana hirsuta*, n. sp. Their figures and descriptions leave no doubt in my mind that they have had before them the original species for which the genus was instituted

For distinguishing this genus from the other members of the family it is convenient to remember that *Alcirona* alone has the apex of the outer plate in the first maxillae armed with two spines, that *Tachaea* alone has the joints of the maxillipeds reduced to six, apparently by coalescence of the second and third, and that in *Lanocira* the second joint of the maxillipeds (leaving out of count the expansion in the female) is very little longer than broad, but very much longer than broad in *Corallana*.

4. *Corallana hirsuta*, Schiödte and Meinert. Pl. L B.

Corallana hirsuta, 1879, Schiödte and Meinert, *Naturhist. Tidsskr.*, Ser. 3, Vol. XII. pp. 287, 297, Pl. 5, figs. 11, 12.

Dana, in describing *Corallana hirticauda*, from the coral reefs of Tongatabu, writes as follows:—'Body moderately narrow, posterior half of back to extremity of abdomen hirsute. Head a little transverse. Eyes large. Antennae very unequal; second pair long, reaching to fifth segment of thorax; flagellum about eighteen-jointed; first pair not much longer than

base of second. Abdomen six-jointed, last segment triangular; sides straight; extremity rounded. Caudal stylets not extending beyond abdomen, branches obtuse, outer much the narrower, not longer than the inner. Feet short setulose.'

Neither in this nor in the much fuller account given by Schiödte and Meinert can I find any character except one to justify the separation of their *C. hirsuta* from Dana's *C. hirticauda*. Dana says that the outer branch of the uropod is 'not longer than the inner,' and figures it as somewhat shorter. Schiödte and Meinert say that the inner branch is scarcely shorter than the outer, implying that the outer if anything has the advantage, which in their figure they give it very decidedly. But on the other hand they say that in their own *C. hirsuta* the inner branch is much shorter than the outer. This again is borne out by their figure and corresponds with what is observed in the specimens of the present collection. All of them appear to have this particular feature, so that with reluctance I allow them to stand under the name which separates them from Dana's original species.

The body is depressed, so that here, as in other species of the genus, it shows the side-plates even in a dorsal view. The very hirsute telsonic segment has bisinuate sides converging to a rather broad slightly convex apex which carries eight spines.

The first antennae are prominent and contiguous at the base, with a broad, not very long, composite basal joint, only a little longer than the next or true third joint. The flagellum has 11 joints, most of them carrying sensory filaments, the first joint much shorter than the second. The second antennae have the first three joints very short, the fourth subequal in length to the fifth, widest at its base, this character appearing in both sexes and the young, but most developed in the male. The joints of the flagellum numbered 21 in one male specimen, but only 15 in another, 20 in a female, 14 in a little young specimen.

The mandibles end in a short uncinate tooth accompanied by a small trifid plate; there is a slight marginal prominence, perhaps representative of a vanished molar; the second joint of the palp is the longest, both this and the third being in the distal part fringed with setiform spines.

The first maxillae have a narrow inner plate, slightly expanded at its apex; the outer plate ends in a strong unciform tooth.

The second maxillae are feeble, simple, with narrowly rounded apex.

The maxillipeds are narrow, only the second joint elongate, the fourth and fifth with length and breadth subequal in the male but broader than long in the female, the sixth and seventh joints small in both sexes.

The first gnathopods are short and stout, with four robust spines on the fourth joint, between which and the sixth joint the fifth makes very little show. The spines on the sixth joint are not robust. The finger is curved with a strong unguis.

The second gnathopods have the fifth joint very short but quite distinct, being otherwise very similar to the first gnathopods.

The first peraeopods are very like the second gnathopods. In the following pairs the fifth joint attains greater importance, and the joints from the third to the sixth have longer spines and a greater variety. In the last three pairs the fifth joint carries several spinose spines on the apical border.

The very broad inner ramus of the uropods in addition to numerous setae carries nine spines on the broadly rounded distal margin. The longer but very much narrower outer ramus has a fringing of long setae with spines at intervals, the apex subacute.

Colour, a pale ground sometimes strongly marbled with dark-brown stellate flecks, sometimes carrying only more or less distant spots of brown.

Length. A specimen here and there a little exceeded the length of 10 mm., but as a rule specimens, even those loaded with young ones, did not reach fully 9 mm. Dana gives the length of his species as nearly five lines, which may be reckoned as equivalent to 10 mm. Schiödte and Meinert describe an ovigerous female of Dana's species, which was 6·5 mm. long. Of their own species the ovigerous female described was 8·5 mm. in length, and the 'virgo' 9—9·5. As they had two specimens of the latter form, it may be inferred that they differed slightly in size. In their 'conspectus specierum' these authors distinguish *C. hirticauda* as having 'Cauda media obscure bisulcata vel subaequata' and 'Oculi aequati vel subaequati' from *C. hirsuta*, with 'Cauda media manifesto bisulcata' and 'Oculi manifesto granulati.' In the present collection the bisulcation of the pleon is quite obscure, but whether the eyes are less granular than in Schiödte and Meinert's specimens I have no means of determining.

Locality. Minikoi, from rotten log in the lagoon, some of them marked as coming from borings (possibly of *Teredo*) in the rotten wood. With them were some specimens of *Limnoria*.

Gen. *Lanocira*, Hansen.

Lanocira, 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Pt. 3, pp. 287, 313, 391, 395; 1893, Stebbing, *History of Crustacea*, p. 346.

Hansen, having only a single species at command, notes that in this genus, as distinguished from *Alcirona*, the hinder part of the body is naked, that is to say, not setigerous. But this character is not applicable to the new species about to be described.

5. *Lanocira gardineri*, n. sp. Pl. LI A.

The head (at least in the adult male) has the front upturned into a little horn, and near the hind margin, adjacent to the rather large dark eyes, there are a pair of tubercles. The appearance is therefore something like that of *Excorallana tricornis* (Hansen). The first segment of the peraeon is considerably the longest, the seventh the shortest. The front side-plates are rounded behind, the three hinder pairs somewhat quadrate and obliquely ridged. The first segment of the pleon is medio-dorsally obsolete; the fifth has its angles a little produced but flanked by those of the fourth segment. The telsonic segment has the sides very slightly sinuous, fringed with setae, and converging to a rather broad truncate apex carrying plumose setae and six spines. The dorsal surface of this segment is armed with twenty-six rather spine-like setae, and there are a few on other parts of the back.

The first antennae have the first and second joints coalescent, lying under the projecting front of the head, the third joint a little shorter than the composite one, the six-jointed flagellum shorter than the peduncle, and the whole appendage not longer than the peduncle of the second antennae. This is robust, with the first three joints together equalling the stout but not very elongate fourth, the fifth shorter and much narrower than the fourth. The flagellum, slightly longer than the peduncle, has numerous setae on the first seven of its thirteen joints.

The frontal lamina is pentagonal. The mandibles, as usual in this family, are very firmly attached to the lower lip, and have their free ends closely clipped in by the short upper lip. The trunk of the mandible, besides having a curved margin, makes a rather strong bend of the whole plate near the narrowed centre. The apex has no well-defined uncinate tooth as in *Corallana* and *Excorallana*, but some ill-defined dentations, accompanied by a row of spine-teeth, which on one of the mandibles point backward. The palp is attached near the base, and has the middle joint the longest.

The outer plate of the first maxillae ends in a single, very long, strongly curved spine, which is only seen in its natural shape when the trunk of the maxilla is set more or less edgewise.

The second maxillae are nearly as in *L. kröyeri*, Hansen, the broad 'lacinia of the second joint' being surmounted by an almost linear third joint which here carries a short seta in addition to the long one described for *L. kröyeri*.

The maxillipeds have the second joint a little longer than wide, the third, fourth, and seventh joints small, and the fifth and sixth not very large.

The first gnathopods have the second and third joints channelled, the third carrying a long spine on the front apex and a stout one on the hinder, the fourth joint is bordered with five stout spines, the apical much the largest; the fifth joint is hidden between its neighbours; the sixth is not strongly armed; the finger is large, and by help of its long nail strongly curved. The second gnathopods scarcely differ from the first in structure, except that the fifth joint is rather more conspicuous. The first peraeopods are like the second gnathopods. The four following pairs are successively longer, otherwise agreeing closely together in structure, the second joint broad, broadest in the fourth peraeopods, the fourth joint with the hind apex broadly produced, the third to the sixth but especially the fifth furnished with numerous spines on the apical border, the sixth joint short, a little longer than the strongly curved finger.

In the second pleopods the male appendage has an acute apex, not nearly reaching the end of the ramus.

The inner branch of the uropods reaches beyond the telsonic segment; it is fringed with plumose setae and has nine spines on the broadly rounded distal margin. The much narrower outer ramus does not reach beyond the telsonic segment; it carries eight spines among a fringing of long setae.

The colour is light, speckled with scattered flecks of brown.

Length a little under 7 mm., by a breadth of nearly 3 mm. Another specimen, smooth-headed, but apparently of the same species, was 4·5 mm. long by 2 mm. broad.

Locality. Mahlosmadulu Atoll, at 20 fathoms, on coarse sand and rubble.

The species is named out of respect to Mr Stanley Gardiner, by whom it was obtained.

6. *Lanocira rotundicauda*, n. sp. Pl. L A.

There is so much resemblance between this and the preceding species that, when the points of difference have been noticed, the question will still remain whether they may not possibly depend on difference of sex and age in the specimens examined.

The form about to be described was a female carrying numerous young ones, with their dark eyes showing conspicuously through the marsupium.

The head is smooth, the telsonic segment is broadly rounded, not at all apically truncate dorsally sprinkled with setiform spines, which seem to be less stiff than those in the other species and not arranged in the same order. Round the apical border the armature was for the most part worn away, but in the young there are six spines with intervening setae just as in *L. gardineri.*

The first antennae have a five-jointed flagellum, its first joint much the longest, the last two minute, as is the case in the young taken from the marsupium.

The second antennae are not specially robust; the flagellum is thirteen-jointed.

The mouth-organs do not give much assistance, because as shown in the figure the first maxilla of the young one is normal, as was also the case with a larger juvenile specimen not taken from the pouch of the mother, but this organ in the mother itself has a comparatively short terminal hook and a short oval inner plate. This form of the first maxilla is probably therefore a casual abnormality. The maxillipeds are very short, with the vibratory plate of the second joint extending to the top of the sixth joint. In the maxillipeds of the juvenile specimens there is nothing to show that the shortness of these appendages is abnormal, but as they are without the vibratory plate of the female comparison is not easy.

The peraeopods are rather more slender than in *L. gardineri.*

Length 5·25 mm., by a breadth of 2 mm. There were also two small specimens, each under 3 mm. long.

Locality. Mahlosmadulu Atoll, taken along with *Lanocira gardineri* at 20 fathoms.

L. kröyeri, Hansen, the type species of the genus, from Rio Janeiro, among other differences has only four spines on the apical margin of the telsonic segment.

Gen. *Alcirona,* Hansen.

Alcirona, 1890, Hansen, *Vid. Selsk. Skr.,* Ser. 6, Vol. v. Pt. 3, pp. 285, 313, 391; 1893, Stebbing, *History of Crustacea,* p. 346.

This genus is well characterized by the very broadly crescentic epistome, the elongate peduncle of the second antennae, and the two-spined apex of the first maxillae.

To the two species for which it was instituted by Hansen, a third is now added. The three may be distinguished as follows:

1	Hinder part of body remarkably setose.	1. *A. krebsii,* Hansen.
	Hinder part of body very moderately setose.—2.	
2	First gnathopods with robustly pectinate finger.	2. *A. insularis,* Hansen.
	First gnathopods with the finger simple.	3. *A. maldivensis,* n. sp.

7. *Alcirona maldivensis,* n. sp. Pl. LI B.

The head is smooth, with a rather blunt rostral point. At the centre of the back the fourth segment of the peraeon is nearly as long as the first, and the seventh not much shorter than the fourth. The first two segments of the pleon are much concealed, the first, however, though very short at the middle is not at that part obsolete as in the species of *Lanocira* here described. The angles of the fourth segment are strongly produced, outflanking the rounded slightly produced corners of the fifth segment. The telsonic segment has the sides

slightly bisinuate, strongly convergent to an apex of very moderate breadth, with four spines on what may be called the truncate part, but another on each side not quite in line with the four, yet completing the series. The distal part of the whole margin is fringed with rather short setae and about eighteen are sprinkled on the surface.

The eyes are large and dark. The first antennae have the third joint at least as long as the composite first and second. The ten- or eleven-jointed flagellum is rather longer than the peduncle, and the whole appendage longer than the peduncle of the second pair. In that the fourth joint is longer than the first three combined, the fifth considerably longer than the fourth, the eighteen-jointed flagellum a good deal longer than the peduncle.

The frontal plate is pentagonal. The epistome stretches on either side much beyond the short and narrow upper lip. The mandibles as mounted *in situ* with their cutting edges under the lip appear to be much like those in *Lanocira*. The first maxillae have a slender, blunt-headed inner plate, and two strong spine-teeth at the apex of the outer plate. The second maxillae end in a smooth ovoid joint with the narrow end uppermost. The maxillipeds are short and compact, a little more robust and with a larger seventh joint than in the female *Lanocira rotundicauda*.

The limbs of the peraeon differ little from the pattern of those in the preceding genus, except that the hinder peraeopods are more slenderly built, with the apical spines of the sixth joint more strongly spinose, and the sixth joint more elongate.

The inner branch of the uropods reaches considerably beyond the telsonic segment. It is fringed with nine spines and numerous setae. The outer ramus is much shorter and much narrower, with eight spines and many setae. Each ramus has a little notch, clearly apical in the outer one, and occupying the outer angle of the inner one.

Colour, light with brown speckling.

Length, about 5 mm., by a breadth of about 2·5 mm.

Locality. Hulule, Maldive Islands. A single specimen, female with young.

Specific name from the locality. Hansen's *A. krebsii* was from the West Indies, his *A. insularis* from Samoa.

Fam. **Cymothoidae.**

For the limitation and extension in which this family is accepted I may refer to the discussion of the synonymy in *South African Crustacea*, Part 1, p. 55, 1900.

Gen. *Cymothoa*, Fabricius.

Cymothoa, 1793, Fabricius, *Entomologia systematica*, Vol. II. p. 503; 1884, Schiödte and Meinert, *Naturhist. Tidsskr.*, Ser. 3, Vol. XIV. p. 223.

The synonymy of the genus could be produced to a considerable length, but would be inappropriate here.

8. *Cymothoa borbonica*, Schiödte and Meinert, 1884.

Cymothoa borbonica, Schiödte and Meinert, *Naturhist. Tidsskr.*, Ser. 3, Vol. XIV. pp. 226, 282, Pl. X. figs. 7–10.

As the present collection includes only two of the small males, this identification may remain open to some question. The head has the incurved, broadly rounded front described by the above-named authors, but the eyes which they speak of as 'evanidi,' are rather large and though dull fairly conspicuous. The first antennae are well separated at the base, eight-jointed, equal in length to the much more slender, nine-jointed second pair. The anterior margin of the first peraeon segment is not so markedly trisinuate as figured in the *Tidsskrift*, and the telsonic segment there spoken of as sulcate in the middle shows in our specimens a slight transverse depression near the base but no longitudinal furrow. It is, as Schiödte and Meinert say, a little wider than the fifth segment of the pleon, but this is in contradiction to the character which they give of their sub-family *Cymothoinae* (*op. cit.* p. 222), in which they say that the pleon has the fifth segment broader than the terminal one. Their statement that the uropods are much shorter than the telsonic segment is quite opposed to their figure, which shows them not at all shorter. In our specimens the difference in length is very small. The rami of the uropods agree with the description by the joint authors, both being obtuse-ended, the outer a little the longer, slightly curving inward, the inner a little the broader.

The male appendage of the second pleopods is stiliform, reaching a little beyond the very broad rami.

Colour, pale, with dark dots minute and distant, little affecting the general appearance.

Length of one specimen 10 mm., breadth 3·75 mm., of the other 8 by 4 mm. Schiödte and Meinert give the length 11·5—14 mm. The breadth, 'duplo longior quam latior,' does not correspond exactly with the figure, which is more than twice as long as the greatest breadth, so that the relation of length to breadth may be taken as to some extent variable.

Locality. Hulule, from 'Gills of large Parrot-fish.'

Fam. **Sphaeromidae.**

References to the literature of this family, with some remarks on the still rather obscure boundaries of the included genera, are given in the *Proc. Zool. Soc. London*, p. 552, 1900; in Willey's *Zoological Results*, Part 5, p. 643, 1900; and in *South African Crustacea*, Part 2, p. 64, 1902. From the Malay Peninsula Mr W. F. Lanchester has recently described a new species under the name *Sphaeroma felix*, in *Proc. Zool. Soc. London*, p. 379, pl. 35, fig. 10, 1902. The character of the maxillipeds is not specified.

Gen. *Exosphaeroma*, Stebbing.

Exosphaeroma, 1900, Stebbing, *Proc. Zool. Soc. London*, p. 553; 1902, *South African Crustacea*, Part 2, p. 64.

Sphaeroma serratum (Fabricius), for which the genus *Sphaeroma* was instituted by Bosc, has the maxillipeds differently constructed from those of almost all the later species, in regard to which these appendages have been described, for, while in those species the fourth, fifth and sixth joints are all produced into conspicuous lobes on the inner side, in the original species there are no such lobes. The species now to be noticed has the fourth and fifth joints very slightly lobed, but the sixth not at all. It therefore occupies an intermediate position between *Exosphaeroma* and *Sphaeroma*, yet so much nearer to the former than to the latter that it cannot well be left in the genus to which Dana assigned it.

9. *Sphaeroma* [*Exosphaeroma*?] *globicauda*, Dana.

Spheroma globicauda, 1853, Dana, *U.S. Expl. Exp.*, Vol. XIII. p. 781, pl. 52, fig. 9 *a*, *b*.

Dana gives the following description:—'Body nearly smooth, in part very fine granulous and pubescent. Abdomen subtriangular, very tumid, excepting the parts towards the margin around; at extremity a deep fissure, which at its inner end is produced a short distance transversely in either direction. Caudal appendages reaching slightly beyond line of abdomen; inner lamella the broader and slightly the longer, broadly rounded at apex; outer having the outer margin much reflexed.' Then, after stating that the habitat was 'Nassau Bay, Fuegia,' he adds:—'Length of body, two and a half lines. The fissure in the extremity of the abdomen is of peculiar depth and shape; the part of the surface of the abdomen anterior to its inner extremity is a little raised, independently of the general globose elevation which characterizes the whole segment anterior to this raised point. The minute hairs of the surface and slight granulation are seen with a lens most distinctly on the caudal segment.'

Specimens from the lagoon at Minikoi agree so well with this account that nothing but the difference of size, which in them scarcely exceeds 3 mm., could cause any doubt as to the identity of the species. An examination, however, of what may confidently be regarded as the sexes of one and the same species leads to the conclusion that the aperture in the telsonic segment belongs only to the male. It is probably a character of the adult, since all the smaller specimens as well as the female carrying young are devoid of this transversely rounded opening. *Cymodoce cordiforaminalis*, Chilton, has the aperture of a rather different shape, but is otherwise a species so similar to the present that it will be interesting to learn whether it exhibits the same sexual difference.

The head has a blunt rostral point between two emarginations. In the male the seventh segment of the peraeon is slightly indented at the middle of the hind margin, which is smoothly convex in the female. The pleon has a very short first segment overlapped by the peraeon. This segment is closely united to a composite segment, probably representing the second to the fifth, the angles of the fourth and fifth being to a certain extent distinct but strongly overlapped by those of the preceding segment.

The eyes are not very large, but prominent, conspicuously faceted. The first antennae have a stout composite basal joint, followed by a third joint not much longer than broad, and much shorter than the first joint of the eight-jointed flagellum, which exceeds the peduncle in length and has sensory filaments on the terminal joints. What is here regarded as the first joint of the flagellum corresponds with the third joint of the peduncle in Chilton's description.

The second antennae are rather longer than the first, the second joint longer than the first or third, the fourth than the second, the fifth than the fourth, but not 'nearly twice as long' as in Chilton's species. The flagellum is nine-jointed.

The mandibles have a strong molar and tridentate cutting edge with accessory plate and spine-row, and three-jointed palp. The inner plate of the first maxillae is tipped with four setae. But none of the mouth-organs appear to offer any very distinctive features except the maxillipeds. These differ in a marked degree from those of *Sphaeroma serratum*, as also from those of *Sphaeroma rugicauda*, Leach, but neither do they fully agree with those that have been described in any of the species of *Exosphaeroma* or *Cymodoce*. The fourth joint is considerably longer than the fifth, and each of these is distally expanded on the inner side,

but without forming an elongate lobe; the sixth is fully as long as the fifth, but much narrower; it is broader and longer than the seventh, but forms no distal lobe. The armature is feeble, except on the apex of the plate of the second joint.

The anterior limbs of the peraeon are rather robust, the first pair distinguished from the rest by the fifth joint underriding the sixth, its triangular form allowing the fourth and sixth joints to meet on their outer margin. In the more elongated limbs of the last three pairs the fifth joint has its share in the lengthening. In all the limbs the finger has a little hooked spine in advance of the small hooked unguis. The male appendages of the last peraeon-segment are elongate, close together at the base, with their stiliform apices a little divergent.

The male appendage of the second pleopod appears to be of unusual breadth at the base, then tapering to a narrow apex at some distance beyond the plate that carries it. In *Sphaeroma rugicauda* this appendage is very long and has a somewhat widened rounded apex.

In the uropods the movable outer ramus is serrate almost all along the outer margin as well as on the rounded apex, in the ramus coalesced with the peduncle the serration reaches up the outer margin barely halfway. Length 3 mm., by a breadth of 1·5 mm.

Locality. Lagoon, Minikoi, along with a specimen of *Ligia.*

Heller in the *Crustacea of the Novara Expedition*, pl. 12, figures three species each with a foramen in the telsonic segment, which he names respectively *Sphaeroma perforata*, Milne-Edwards, *S. stimpsoni*, n. sp., and *S. scabricula*, n. sp. None of them can be confused with the present species. The first is easily distinguished by the long median tooth of the last peraeon-segment. But it claims attention here as having the same sexual difference in the telsonic segment as our species exhibits. Heller is certainly wrong in attributing the circular aperture to the female and the simply notched telson to the male. He also says that the postero-median tooth of the peraeon is shorter in the male than in the female, as to which the reverse may be taken for granted. But his text is plainly contradicted by the explanation of the plate above cited.

Gen. *Cymodoce*, Leach.

Cymodoce, 1814, Leach, *Edinb. Encycl.*, Vol. VII. p. 433; 1902, Stebbing, *South African Crustacea*, Part 2, p. 73.

The difficulties connected with the definition of this and various other genera of the Sphaeromidae are discussed by Mr Beddard in his *Challenger Isopoda, Reports*, Vol. 17, p. 145. Until a monograph of the family is carried out by some patient and skilful hand these difficulties are likely to remain. The incapacity of the animal to become completely globular, the resistance to complete folding of one plate over the other in the uropods, and the presence of a lobe in the excavated apex of the telson, are superficial characters which do not offer very firm ground for generic distinction. The maxillipeds do not differ from those found in *Exosphaeroma gigas*, and in most of the species which I have assigned to that genus.

10. *Cymodoce bicarinata*, n. sp. Pl. LII B.

The head broad, the first segment of the peraeon the longest, the sides of the body very hirsute, and the hind margins of the segments hairy, the sixth and seventh also tuberculose. In the pleon a small first segment is covered by the peraeon, the composite

segment which follows has on the hind margin two sub-median bosses. These are followed on the telsonic segment by two slightly divergent carinae leading to two very large bosses each carrying a crest of hairs. To them succeeds a large median boss. This is followed by a convex-sided apically truncate process emerging beyond the convergent apices of the telsonic emargination. All these parts are strongly fringed with setae, and distinguish the species from *C. pilosa*, Milne-Edwards, which has an otherwise similar pleon, but ending in an almost cylindrical median plate, rounded at the end and not reaching beyond the two lateral apices. In *C. aculeata*, Haswell, the median plate projects beyond the lateral points, but it is differently shaped, and the bosses on the pleon are arranged transversely, not in successive pairs. In *C. tuberculata*, Haswell, the bosses are successive, but of quite different character, and the apices of the terminal notch project beyond the median process.

The eyes are wide apart, the anterior margin of the first peraeon-segment being deeply emarginate to receive them.

The first antennae have a large, bent, composite basal joint, with the following joint not very large. To the stoutly constructed peduncle succeeds a slender flagellum of 14 joints, of which the first is much the longest. In the second antennae the peduncle is not robust, the fifth joint a little longer than the fourth, the flagellum 17-jointed. In the mandibles the principal cutting edge is horny-looking, not dentate. The palp is rather slight. The maxillipeds have the fourth, fifth and sixth joints fully lobed. As will be seen in the figure the palp on one side of the specimen was in process of regeneration. The limbs of the peraeon are of the character usual in this family. The male appendages of the seventh peraeon-segment are rather long, not very acute. In the second pleopods the male appendage is very long, with its narrow inward-curving apical part reaching much beyond the plate to which it is attached.

The uropods are straight, rather narrow, very setose, the outer ramus more obliquely truncate than the inner, which it outreaches, both extending beyond the telsonic segment, the outer having a prominent spine at the apex of its raised outer border. In *C. longistylis*, Miers, the inner ramus has an outward curve, and decidedly outreaches the outer.

Length, 6 mm., breadth, 3 mm.

Locality. Minikoi, from 5 to 7 fathoms in centre of lagoon.

Specific name referring to the carinae on the pleon.

Fam. **Limnoriidae.**

Limnoriadae, 1850, White (part), *List of British Animals in Brit. Mus., Crustacea*, p. 68 (without definition); *Limnoriidae*, 1880, Harger, *Rep. U.S. Fisheries*, Part 6, p. 371; 1893, Stebbing, *History of Crustacea*, p. 367; 1897, Sars, *Crustacea of Norway*, Vol. II. Part 4, p. 74.

The family, as restricted by Harger, still contains a single genus.

Gen. *Limnoria*, Leach.

Limnoria, 1814, Leach, *Edin. Encycl.*, Vol. VII. p. 433; 1867, Bate and Westwood, *Brit. Sessile-eyed Crustacea*, Vol. II. Part 18, p. 349; 1880, Harger, *Rep. U.S. Fisheries*, Part 6, p. 373; 1897, Sars, *Crustacea of Norway*, Vol. II. Part 4, p. 76.

The full definition drawn up by Professor Sars was probably based on the species *L. lignorum* alone. To include the other species undoubtedly belonging to the genus it requires some slight modification. Thus the epipod of the maxillipeds is not always lanceolate, and the outer ramus of the uropods is not always unguiform. Authors generally (myself included) have agreed in speaking of the trunk limbs as similar in structure, but, while no doubt they have some features in common, especially in regard to the terminal couple of joints, they are at the same time uncommonly well provided with distinguishing points. Between the first gnathopod and the fifth peraeopod the contrast is sufficiently striking.

The four species now known, all of them small, pale, setose, and very much alike in general appearance, may be distinguished as follows:—

1	Maxillipeds with epipod shorter than the second joint, outer ramus of uropods unguiform.	1. *L. lignorum* (J. Rathke), 1799.
	Maxillipeds with epipod longer than the second joint, outer ramus of uropods not unguiform.—2.	
2	Both rami of uropods very small.	2. *L. antarctica*, Pfeffer, 1887.
	Only the outer ramus of uropods very small.—3.	
3	Epipod of maxillipeds narrow, mandibular palp diminutive.	3. *L. segnis*, Chilton, 1883.
	Epipod of maxillipeds broad, mandibular palp well developed.	4. *L. pfefferi*, n. sp.

In the well-known species of the Atlantic coast Harger notices that in the mandibles 'below there is a slight tubercle, apparently the rudiment of the molar process.' His conjecture is supported by the rather stronger development of this tubercle in *L. segnis*. Between the acutely lanceolate epipod of the *L. lignorum*, and the forms with rounded apex in *L. segnis* and *L. pfefferi*, the narrow leaf shape in *L. antarctica* offers an intermediate term. In his elaborate description of the last-named species Dr Pfeffer broaches an extraordinary theory that 'the pleopods in general have not the value of a limb but of an epipod, so that accordingly the branchial plates of the Isopoda like those of the Decapoda are epipods, and therefore in a certain sense equivalent formations.' That this view has met with no acceptance was to be expected.

11. *Limnoria pfefferi*, n. sp. Pl. LII A.

The general appearance in close agreement with *L. lignorum*, like which it has the head almost globular, much narrower than the rest of the body, the first segment of the peraeon much the longest with a conspicuous dorsal V-shaped grooving, the side-plates of the second and third segments quadrangular oval, the four following pairs more or less acute, the upper surface of the body beset with hairs of varying length. In the pleon the angles of the first segment are a little less prominent than those of the four following segments; the fifth at the middle is as long as the first four together, and about half as long as the almost circular, flatly saucer-shaped telsonic segment, with the proximal part of which it shares in forming a smoothly rounded median elevation.

The eyes are wide apart, very small.

The first antennae have the second joint subequal to the third, not shorter as in *L. segnis* and *L. lignorum*, and the second joint of the flagellum is not so abruptly narrower

than the first, as in the latter species. The long olfactory setae are present. The second antennae closely resemble those of *L. lignorum*. The epistome, lips, mandibles, and both pairs of maxillae agree with those of the last-mentioned species. The maxillipeds also are nearly the same in structure, but with a differently shaped epipod. This is little more than twice as long as broad, broadly rounded at both ends, reaching well beyond the long narrow second joint of the maxilliped, the ovoid form impaired only by the lower part of the inner margin being slightly concave. This appendage in *L. segnis* is about four times as long as broad, and is apically acute in the other two species.

The first gnathopods are as usual distinguished from the other limbs by the fifth joint underriding the sixth, and having no free hind margin. Along front and hind margins of the third and along the hind margin of the three following joints small blunt spines are discernible. At the hinder end of the sixth joint there is a prominent spine with a convex comb as in *L. lignorum*, and the finger just above its long curved nail has the well-known bifid spine. The other limbs agree closely in shape and armature with those of the last named species, the first and second peraeopods being the smallest, but distinguished by their position as confronting one another. The fifth peraeopods are the longest, with the second joint much narrower than in the preceding pairs; the fourth joint is produced far over the hind margin of the fifth, the length of its slender spine-fringed process being particularly conspicuous in the new species; the fringe of pectinate spines round the fifth joint is found in all the species. The spine above the finger-nail is bifid only in the first gnathopods. The pleopods except in the last pair have the inner plate narrowly oblong. The male stylet of the second pair I have not observed. Probably, as in the other three species, and as in the genus *Eurydice*, it is affixed near the middle of the inner margin.

The uropods have the inner ramus shorter than the stout peduncle, twice the length of the small straight outer branch, all the constituents being setose. The peduncle is much larger in comparison with the inner ramus than in *L. segnis*.

Length of unrolled specimen 3·5 mm., breadth 1·25 mm.

Locality. Rotten wood in lagoon, Minikoi.

EPICARIDEA.

Epicarida, 1882, Sars, *Forh. Selsk. Christian.*, No. 18, p. 18; *Epicaridea*, 1893, Stebbing, *History of Crustacea*, p. 392; *Bopyridae*, 1895, Hansen, *Isopoden...der Plankton-Exp.*, p. 18; *Epicarida*, 1898, Sars, *Crustacea of Norway*, Vol. II. Pt. 11, p. 193; *Épicarides*, 1900, Bonnier, *Contr. à l'étude des Épicarides les Bopyridae*, p. 90.

Of the seven families recognized by Giard and Bonnier, Sars rejects the Micronisciadae, 'as only representing transitory larval stages of different Epicarida,' and combines the Cyproniscidae, Cabiropsidae, and Cryptoniscidae under the last of those names. Bonnier a little later upholds the Micronisciadae, and distinguishes in all twelve families.

Fam. **Bopyridae.**

As this is not the place to explain the various extensions and restrictions which authors have assigned to this family name, it will be sufficient to refer to the bibliographical index in M. Jules Bonnier's admirable monograph, *Contribution à l'étude des Épicarides les Bopyridae*.

published in the year 1900, and to the discussion of this group by Professor Sars in 1898. The latter author, while highly commending the services rendered to our knowledge of the Epicaridea by MM. Giard and Bonnier in 1887 and subsequent years, raises a protest against the assumption that the mere statement of the host is sufficient to identify the parasite. He points out that 'one and the same species of Crustacea not seldom is found to be infested by several species of parasites.' So far as at present known the Bopyridae are parasitic only on decapod Malacostraca. It is a little confusing that M. Bonnier should make the Bopyridae one of the families of a section Bopyrinae, when Dr Hansen has already made the Bopyrinae one of the subfamilies of the Bopyridae.

Tylokepon, n. g.

Among the various genera closely allied to *Kepon*, Duvernoy, 1840, *Leidya*, established by Cornalia and Panceri in 1861, is the only one founded on the male sex, and this is unique in the possession of elongate uropods. Among those dependent on characters of the female, *Gigantione*, Kossmann, 1881, alone has in that sex biramous uropods. *Ergyne*, Risso, 1816, the *Portunicepon* of Giard and Bonnier, agrees with *Kepon* and is distinguished from the rest by having the branches of the pleopods more nearly equal. *Cancricepon*, Giard and Bonnier, 1887, has a medio-dorsal boss on each of the last four peraeon-segments. *Trapezicepon*, Bonnier, 1900, has none of these. *Grapsicepon*, Giard and Bonnier, 1887, has a medio-dorsal boss on each of the last two peraeon-segments, and herein it agrees with the new genus, which differs from it in that, instead of a simple boss on the sixth peraeon-segment, the boss there is strongly trifid. The head also furnishes a striking character for the new genus, being formed as it were of two short stout cylinders with rounded ends, of which the inner ones look as if they were flattened below where they meet, forming nearly a right angle.

The name of the genus is formed in allusion to its affinity with *Kepon*, and to the fact that the parasitic species for which it is instituted was found in the branchial region of *Tylocarcinus styx* (Herbst) as identified by Mr L. A. Borradaile, through whom I received the specimens.

Though the generic characters above given may not be thought of very high value, they fall well into line with those of the kindred genera already established, and under existing circumstances a new generic name seemed rather a matter of necessity than of choice.

12. *Tylokepon bonnieri*, n. sp. Pl. LIII.

♀. The appearance of the prominent white head has been already described. The peraeon from its opaque orange colour did not show clearly either the division of the segments or the contour of the lateral bosses, but the triple boss in the middle of the sixth segment was white and stood out clearly. The single median boss on the seventh segment was also white and directed somewhat upwards. When mounted this proved to have its rounded end marked off by a slight constriction. The laminae of the first pleon-segment are very large, strongly tuberculate on the upper surface and edges. The following pairs are successively smaller.

The first antennae are very small, three-jointed; the second a little larger, five-jointed.

The 'buccal rostrum' and the pair of maxillipeds, each member of which is consolidated into a single piece of great breadth at the centre with a narrow incurving apex to represent the terminal joints, differ very slightly from the corresponding parts in *Cancricepon* (see

Bonnier, *op. cit.* Pl. VII. figs. 3, 4). The strong muscles are conspicuous in their large but shallow cavity. Below the maxillipeds is that which Bonnier designates as the lower cephalic lamina. This in *Cancricepon elegans*, Giard and Bonnier, forms three lobes on either side in such a way that the outermost are produced furthest backward and the innermost the least far. In the present species the central piece, though pretty strongly emarginate, is scarcely bilobed, and by extending back much beyond the two lateral pairs of lobes appears to differ from the corresponding part in all the neighbouring genera.

The vast marsupial plates attached to the minute first gnathopods have as usual the anterior section underlying much of the maxillipeds, this part being produced on the inner (upper) surface into a broad sculptured lappet overlying a piece of the plate's hinder section. On the outer (ventral) surface the two sections pass smoothly into union, the upper one having a convex groove near the proximal part of the leg. The first gnathopods differ from the rest of the limbs chiefly in having the fifth joint smaller and more completely overlapped by the compact sixth joint. The second and third joints increase in size in the successive pairs of limbs to the fourth peraeopods. In both the fourth and fifth peraeopods the second joint is rather remarkable for the bulging of the two margins, and the third joint is greatly widened distally.

The pleopods have the outer branch similar to the pleural laminae of the segment, but smaller, and the inner branch very much smaller than the outer, with the margins a little irregular, at least in the earlier pairs, and perhaps in all.

The uropods are single-branched, long and slender, very much crumpled in the spirit specimen.

Length 3 mm., with a breadth of about 2·5 mm.

Locality. The specimen had been already extracted from the host, *Tylocarcinus styx*, which was taken at 'Hulule, Malé Atoll, Maldives,' and which showed on the left branchial region of the carapace the cavity that had been occupied by the parasite.

The specific name is chosen in compliment to M. Jules Bonnier, whose finely executed and instructive work on this group of the Isopoda has been more than once referred to above.

In the same bottle with the specimen just described there were four other isopods, which I am disposed to regard as belonging to the same species, although, as Sars rightly argues, Idem propterea non est, quia captus ibidem.

♂. This minute creature bears a very near resemblance to the males of *Cancricepon elegans* and *Grapsicepon edwardsi*, as figured by M. Bonnier. It would be an extraordinary chance that the female parasite of *Tylocarcinus* should have reached England from the Maldives, without a male of its own species, but accompanied by a male belonging to some other species of the same family.

The present specimen is probably not mature, since it has second antennae reminiscent of the cryptoniscus-stage. The pleopods also are more strongly developed than in the adult of *Cancricepon elegans*, but in correspondence with the bopyrian stage of that species. No dorsal or ventral bosses were perceptible.

The eyes are dark, longer than wide. The limbs all nearly alike, with the fourth and fifth joints very small, the sixth compact. The terminal segment of the pleon is bilobed, the lobes a little prolonged, each with a minute seta at the apex and another at the side.

Length estimated at half a millimetre.

The cryptoniscus-stage, whether of this or some other species, was represented by three specimens, smooth, narrow, sharply tapering to the uropods, the head broader than long, with a pair of gleaming eyes. In describing *Liriopsis pygmaea* (Rathke) Sars says, 'eyes very distinct, each consisting of a dark pigment, within which is imbedded a single rather large, refractive lenticular body.' The dorsal view which he gives of that species is in fair agreement with the specimens now under notice, but in these the ocular pigment is not dark, and the fourth and fifth peraeopods have not the peculiar shape characteristic of *Liriopsis*.

The first and second gnathopods are compact, subchelate, with the fifth joint apparently in coalescence with the sixth. The peraeopods are slender, all having the fourth and fifth joints very small, the fifth triangular, underriding the sixth. The second joint is widest at the middle and narrow at both ends; the third, which is rather shorter but broader, is narrow only at the base; the sixth like the second and third has a convex outer and more or less straight inner margin; near the apex of the latter it carries a fine spine and in the first three pairs two minute spinules on the widened apical margin, but a single spine on the comparatively narrow apex of the last two pairs. The finger is thin, slightly curved, longer on the fourth and fifth peraeopods than on the three preceding pairs, but in none longer than the sixth joint.

The pleopods have a broad but short peduncle armed at the inner angle with two long spines. The rami are short, not longer than the peduncle, each carrying four long plumose setae, the outer which is the less robust having in addition a short plumose seta at the outer angle.

The uropods have short peduncles, quite as broad as they are long. The outer ramus, scarcely longer than the peduncle, carries a long seta and two that are shorter. The inner ramus, more than twice the length of the outer, tapers to the apex, which nearly agrees with that of the outer ramus in armature.

Length 1·5 mm., with a breadth of about 0·4 mm.

ONISCIDEA.

Fam. **Ligiidae.**

Gen. *Ligia*, Fabricius.

For references to the bibliography of tribe, family, and genus, the reader may be invited to consult Willey's *Zoological Results*, Part 5, p. 645, 1900.

13. *Ligia exotica*, Roux[1].

Ligia exotica, 1828, Roux, *Crust. de la Médit. et de son littoral*, Livr. III. Pl. XIII. fig. 9; 1885, Budde-Lund, *Isopoda terrestria*, p. 266.

Budde-Lund, from whom the reference to Roux is taken, gives a full synonymy. The single specimen in the present collection was a female without the uropods, the flagellum of the second antennae having about thirty-eight joints, the telsonic segment agreeing well with Dana's figure of that part in the species which he names '*Lyg. gaudichaudii*?,' adopting the specific name from Milne-Edwards. Budde-Lund puts both the French author's and Dana's names in the synonymy of *L. exotica*.

Locality. Lagoon, Minikoi. Taken along with *Sphaeroma* [*Exosphaeroma*?] *globicauda*.

[1] See "Land Crustaceans," by L. A. Borradaile, *Fauna Geogr. Maldives*, etc., vol. I. p. 98.

EXPLANATION OF PLATES.

PLATE XLIX A. *Calathura borradailei*, n. sp. (p. 700).

n. s. Natural size, that is, length when fully extended, of specimen represented in the adjoining figure, lateral view, curved position.

C. Cephalon with first peraeon segment in dorsal view.

Pl. Pleon with last peraeon segment in dorsal view.

a. s., *a. i.* Upper and lower antennae.

m., *mx.* 1, *mxp.* Mandible, first maxilla, maxillipeds.

gn. 1, *prp.* 1, *prp.* 5. First gnathopod, first peraeopod, fifth peraeopod, with higher magnification of some spines of *prp.* 1, and of finger tip of *prp.* 5.

plp. 1, *plp.* 2. First and second pleopods, with higher magnification of distal part of male appendix.

T., *urp.* Telson and uropods, ventral view. This figure and all the figures of separate appendages are magnified to the same scale, except those of the mouth-organs, which are on the same scale as the enlarged details of *prp.* 1, 5, and *plp.* 2.

PLATE XLIX B. *Cirolana sulcaticauda*, n. sp. (p. 701).

n. s. Lines indicating natural size of specimen figured below in dorsal and lateral views.

a. s., *a. i.*, *m. m.* First and second antennae, and mandibles, above which are the upper lip, epistome, and frontal lamina.

mx. 1, *mx.* 2, *mxp.* First and second maxillae, and the maxillipeds.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

plp. 2. Second pleopod.

Pl. Pleon in dorsal view, less highly magnified than the rest of the details, which are on a uniform scale.

PLATE L A. *Lanocira rotundicauda*, n. sp. (p. 707).

n. s. Natural size of female specimen figured below in dorsal view.

a. s., *a. i.* First and second antennae.

m., *mx.* 1, *mx.* 2, *mxp.* Mandible, first and second maxillae, and maxilliped.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

Pl. Pleon less highly magnified than the foregoing details, and these than the following.

mx. 1, *juv.* First maxilla of young extracted from the maternal pouch.

Pl. juv. Pleon of the same juvenile specimen.

PLATE L B. *Corallana hirsuta*, Schiödte and Meinert (p. 704).

n. s. Lines indicating natural size of female specimen figured below in dorsal view.

a. s. ♂. First antenna of male, with part of head showing facets of eye.

a. i. ♂. Second antenna of male, flagellum incomplete.

mxp. ♂. Maxilliped of male.

prp. 5. ♂. Fifth peraeopod of male.

m. Mandible of female; this and following details not from the specimen figured in full.

l. i. Lower lip of female, in lateral view.

mx. 1, *mx.* 2, *mxp.* First and second maxillae, and maxillipeds of female.

gn. 1. First gnathopod of female.

Pl. Pleon of female, less highly magnified than the other details.

PLATE LI A. *Lanocira gardineri*, n. sp. (p. 706).

n. s. Natural size of male specimen figured below in dorsal and dorso-lateral view.

a. s., *a. i.* First and second antennae.

m. m. Mandibles, with cutting edge of one more highly magnified.

mx. 1, *mx.* 2, *mxp.* First and second maxillae and maxillipeds.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

plp. 2. Second pleopod.

Pl. Pleon, less highly magnified than the foregoing details.

PLATE LI B. *Alcirona maldivensis*, n. sp. (p. 708).

n. s. Natural size of female specimen figured below in dorsal view.

a. s., *a. i.*, *m. m.* First and second antennae and mandibles surmounted by upper lip, epistome, and frontal lamina.

mx. 1, *mx.* 2, *mxp.* First and second maxillae and maxillipeds.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

Pl. Pleon in dorsal view, less highly magnified than the foregoing or following details.

a. s., *a. i.*, *juv.* First and second antennae, with part of head showing the eyes, in a specimen extracted from the maternal pouch.

Pl. juv. Pleon of the same juvenile specimen.

PLATE LII A. *Limnoria pfefferi*, n. sp. (p. 714).

n. s. Natural size of specimen figured below in dorsal view.

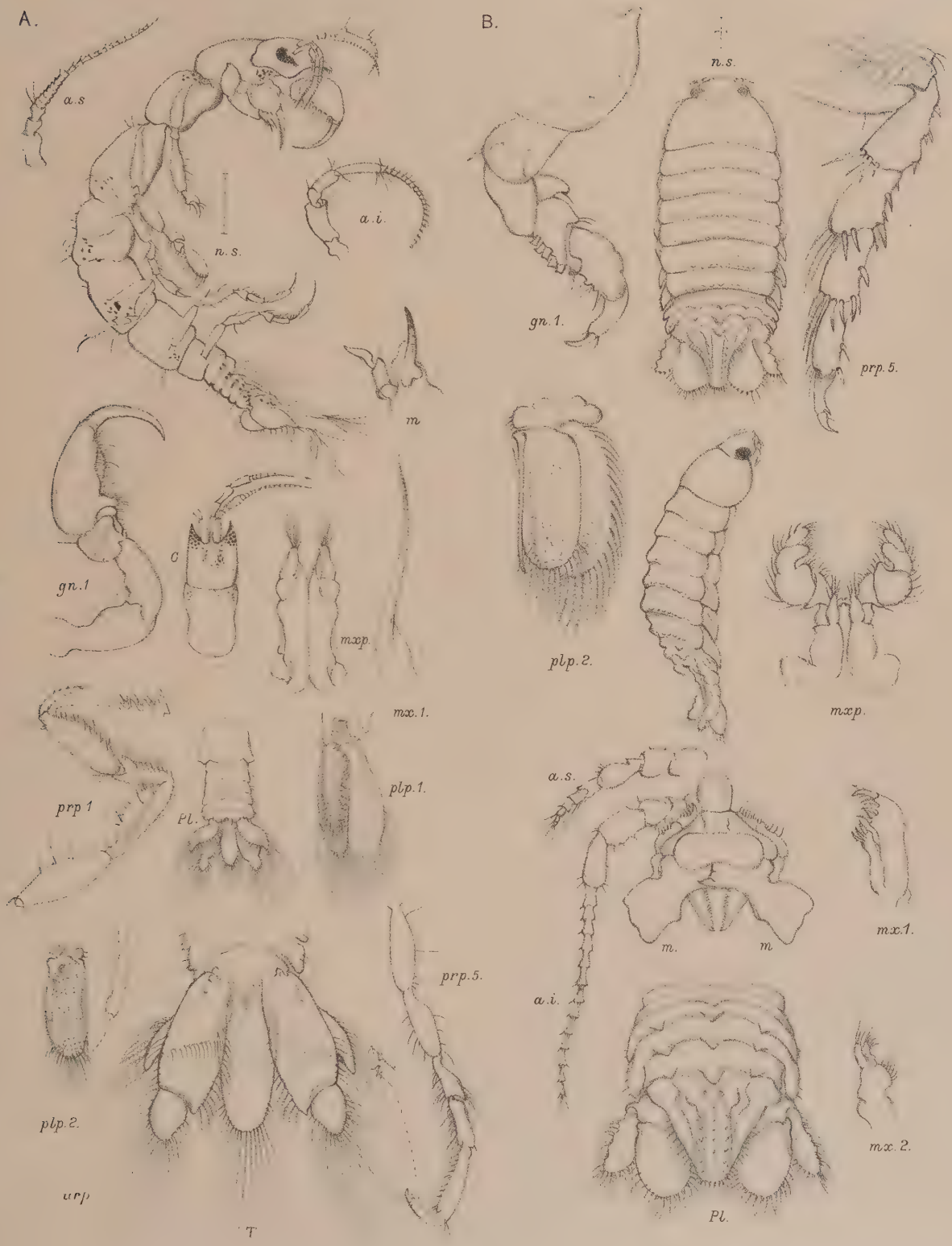
a.s., *a.i.* First and second antennae.

l. s., *l. i.* Upper lip with epistome, and lower lip.

m. m., *mx.* 1, *mx.* 2, *mxp.* Mandibles, first and second maxillae, maxilliped.

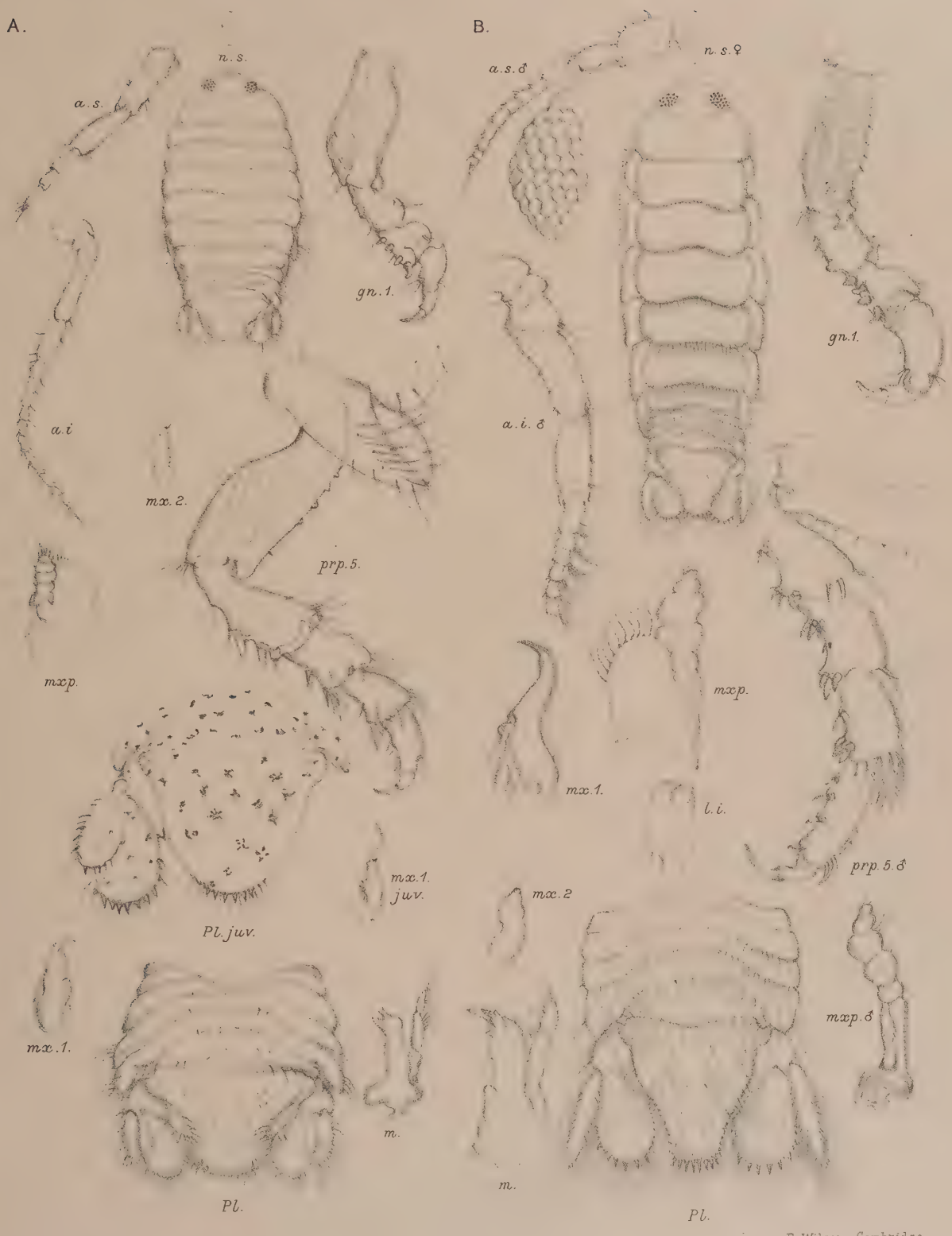
gn. 1, *gn.* 2, *prp.* 5. First and second gnathopods and fifth peraeopod, with parts more enlarged.

urp., *Pl.* Uropod in two aspects, pleon in dorsal view.



T.R.R. Stebbing del. E. Wilson, Cambridge.

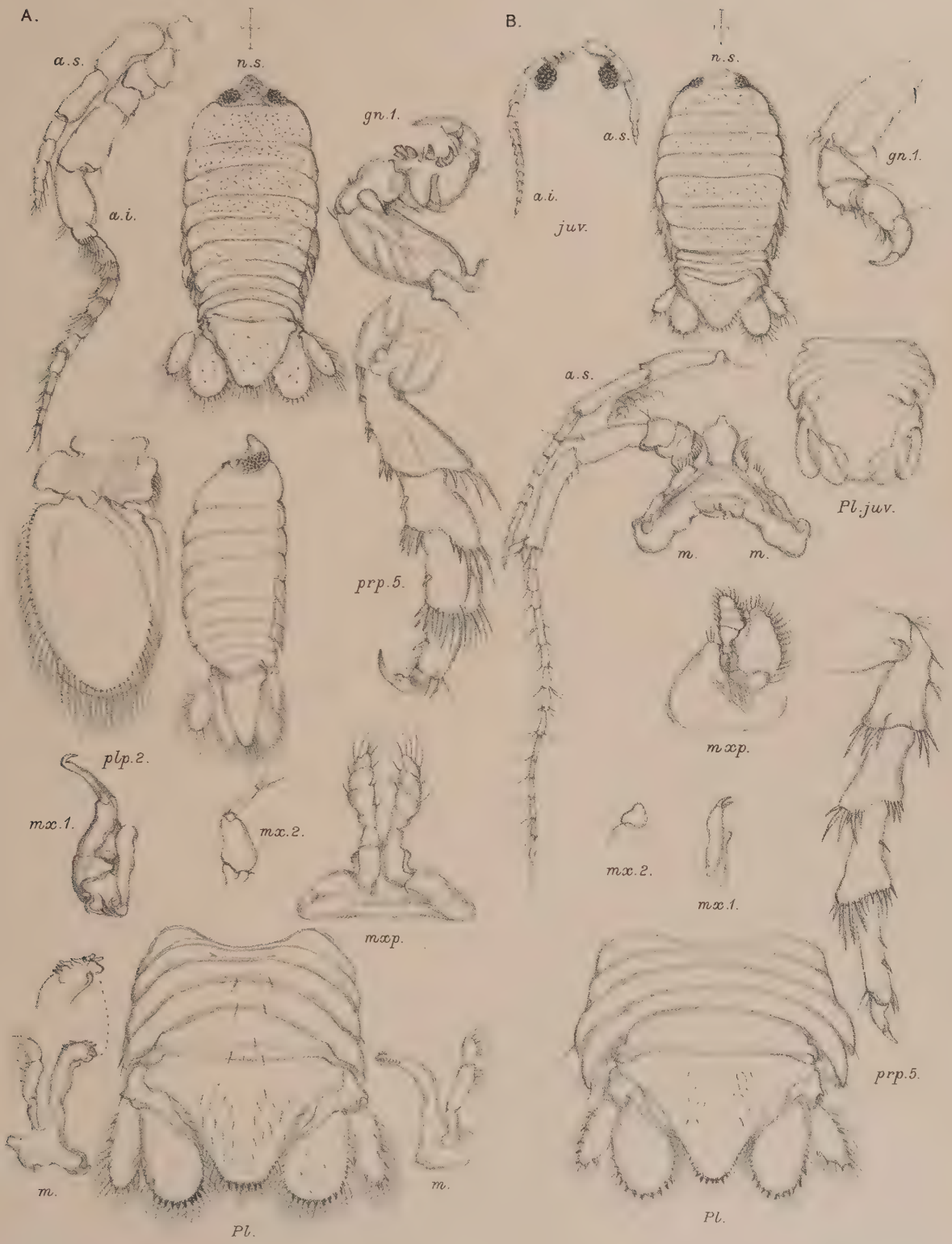
CALATHURA BORRADAILEI, n.sp. CIROLANA SULCATICAUDA, n.sp.



T.R.R. Stebbing, del. E. Wilson, Cambridge.

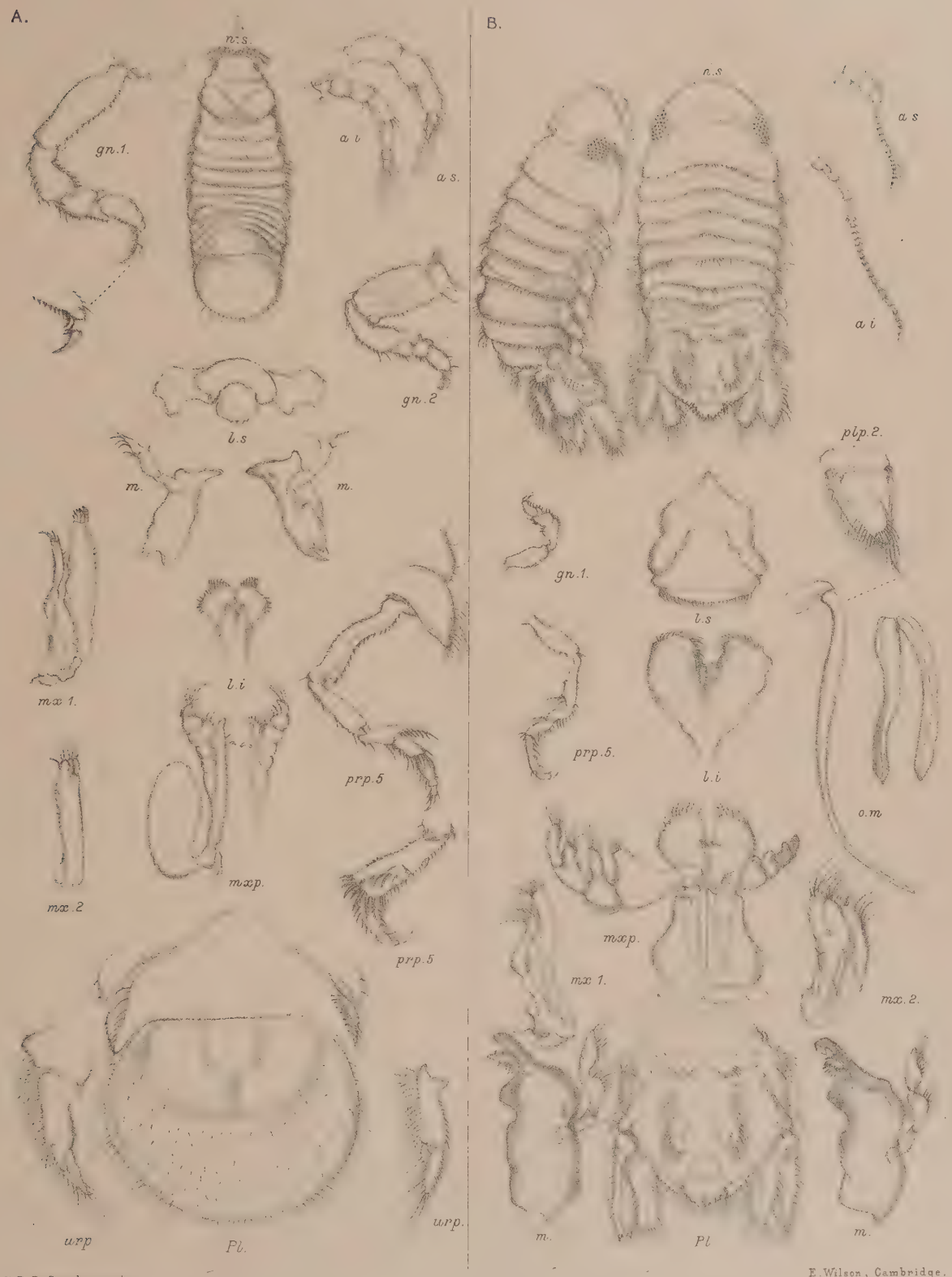
LANOCIRA ROTUNDICAUDA, n.sp.

CORALLANA HIRSUTA, Sch. & Mein.



T.R.R.Stebbing, del. E.Wilson, Cambridge.

LANOCIRA GARDINERI, n.sp. ALCIRONA MALDIVENSIS, n.sp.

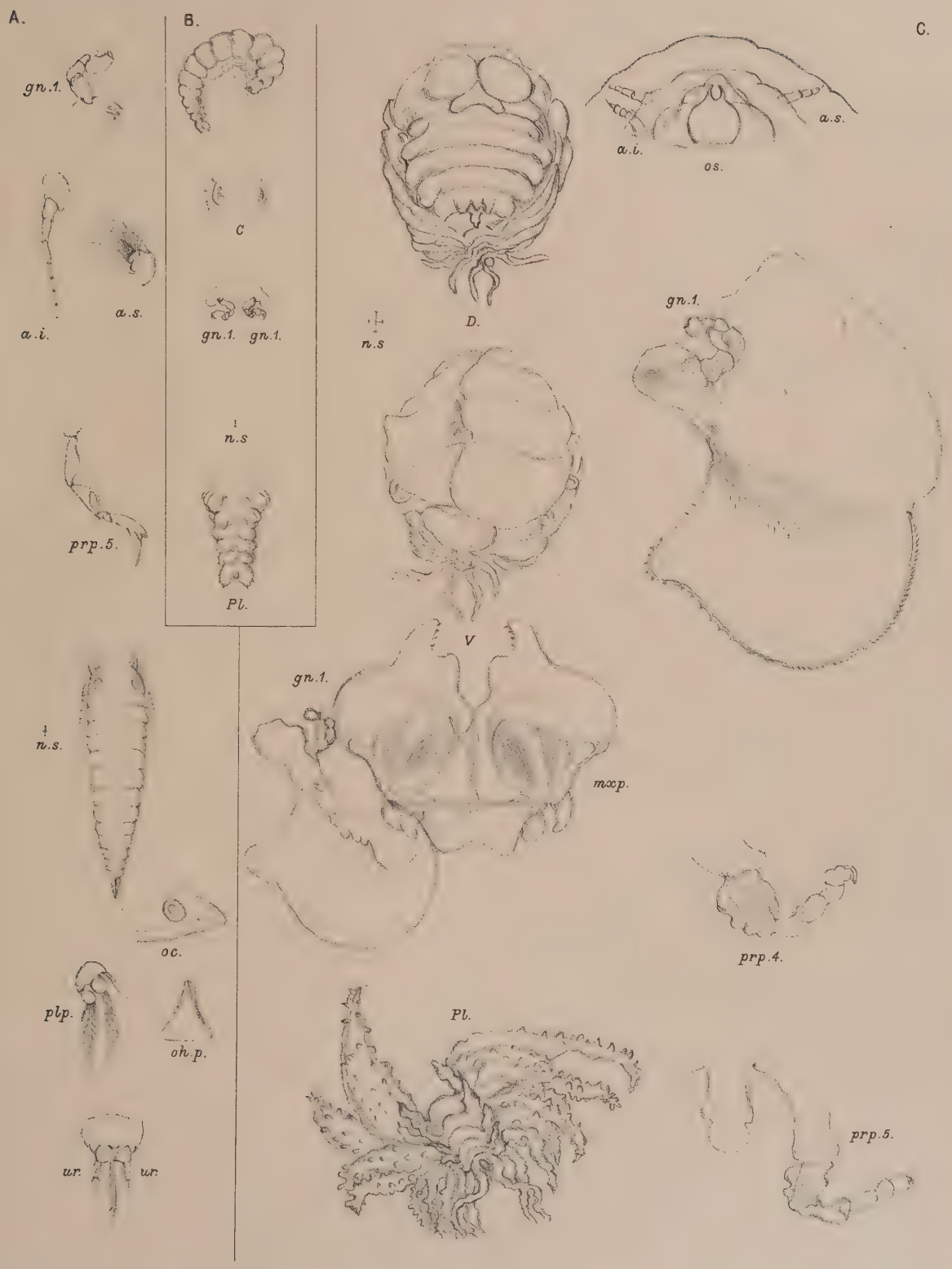


T R P Stebbing del.

E. Wilson, Cambridge.

LIMNORIA PFEFFERI, n. sp.

CYMODOCE BICARINATA, n sp.



T. R. R. Stebbing, del. E. Wilson, Cambridge.

A. CRYPTONISCUS. STAGE: C. ♂: B. ♀: TYLOKEPON BONNIERI n.g. et sp.

PLATE LII B. *Cymodoce bicarinata*, n. sp. (p. 712).

n. s. Natural size of male specimen figured below in dorsal and lateral views.

a. s., *a. i.* First and second antennae.

l. s., *l. i.* Upper lip with epistome, and lower lip.

m. m., *mx.* 1, *mx.* 2, *mxp.* Mandibles, first and second maxillae, and maxillipeds.

gn. 1, *prp.* 5, *plp.* 2. First gnathopod, fifth peraeopod, second pleopod.

o. m. Male appendages of seventh peraeon segment and second pleopod, these and the mouth-organs being much more highly magnified than the antennae, limbs, and pleon.

Pl. Pleon in dorsal view.

PLATE LIII A, B, C. *Tylokepon bonnieri.*

A. (p. 718).

n. s. Natural size of Cryptoniscus-stage in dorsal view to the right.

oc. Eye in lateral part of the head, as seen when flattened out.

a. s., *a. i.*, *or. p.* First and second antennae, and oral parts.

gn. 1, *prp.* 5, *plp.*, *urp.* First gnathopod, fifth peraeopod, a pleopod, uropods and end of pleon.

B. (p. 717).

n. s. Natural size of supposed male in curved position figured above laterally.

C. Head with antenna of one side.

gn. 1, *gn.* 1. First gnathopods in attachment to the segment.

Pl. Pleon in ventral view.

C. (p. 716).

n. s. Natural size of female specimen figured to the right in dorsal and ventral views.

a. s., *a. i.*, *os.* First and second antennae and mouth *in situ.*

mxp., *gn.* 1. Maxilliped and first gnathopod in their relative position, first gnathopod separately more highly magnified.

prp. 4, *prp.* 5. Fourth and fifth peraeopods on the same scale as the separated *gn.* 1.

Pl. Pleon in dorsal view.

HYDROMEDUSAE,

WITH A REVISION OF THE WILLIADAE AND PETASIDAE.

By Edward T. Browne, B.A., *Zoological Research Laboratory, University College, London.*

(With Plates LIV.—LVII.)

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INTRODUCTION.

ALTHOUGH the collection does not contain many specimens, a few more would have been a distinct advantage, and the species are not numerous; it has, nevertheless, brought to light some interesting medusae. It is a welcome addition to our knowledge of the Hydromedusae of the Indian Ocean, and I express my sincere thanks to Mr Stanley Gardiner for allowing me the privilege of examining the specimens.

The Anthomedusae and the Leptomedusae of the Indian Ocean are not well known and a very few species have been recorded. There are five species in this collection and four of them are new to science. The medusae belonging to these two Orders are usually found in littoral waters and seldom far away from land. They are liberated, with few exceptions, from fixed hydroids, and consequently their geographical distribution is limited to the region occupied by their hydroids. A genus often has a wide geographical range, but seldom its species, which are usually confined to definite areas, or even to certain localities, so that some of the new species belonging to the Anthomedusae and the Leptomedusae are probably limited to the Maldive Islands.

The Trachomedusae, the Narcomedusae and the Siphonophora have no fixed stage in their life-history and they are the inhabitants of the oceans, drifting hither and thither with the currents. Their species have usually a very wide geographical range and some extend over the Atlantic, Indian, and Pacific Oceans. Although Mr Gardiner made extensive use of the tow-net, yet a very few specimens of the Oceanic medusae were taken, and considering the geographical position of the Islands one would have expected to have seen a more extensive collection.

SUMMARY.

In the revision of the Williadae I have used for the generic character the number of radial canals which leave the stomach, and for the specific character the branching of the canal system. There are now two genera, namely, *Proboscidactyla* and *Willia*. The genera *Dyscannota* and *Willetta* of Haeckel are no longer needed. In three species of the Williadae I have found that the circular canal is absent and that its place is occupied by a solid chord of endoderm cells. The radial canals are in direct communication with the basal bulbs of the tentacles.

Mesonema pensile, one of the Aequoridae, has the lower wall of the stomach quite rudimentary, so that the mouth must always remain very wide open. I have failed to see how this stomach can act as a digestive organ and have suggested that the canal system has taken on the function of a stomach. This may also apply to other Aequoridae and account for the large number of radial canals and the excretory pores on the circular canal. The Maldive specimens are exactly like a figure of a medusa given by Forskål (1771), afterwards called *Mesonema pensile*. I cannot find any evidence that this medusa has been taken since Forskål's time. The Aequoridae require a thorough revision, but this can only be properly done with the aid of a sufficient number of specimens as most of the species now have imperfect descriptions. Special attention should be paid to the shape of the basal bulbs of the tentacles. So far I have found the shape to be different in every species which I have examined.

As the shape is constant for each species in all stages of development, it is easy to identify the early and intermediate stages, which are liable to be described as distinct species and perhaps placed in different genera.

The revision of the genera belonging to the Petasidae has not involved any alterations in generic names. The structure of the sense organs has been taken for the character of the two subfamilies, Petnachnidae and Olindiadae, instead of the absence or presence of centripetal canals, which was used as the subfamily character by Haeckel. The genera *Aglauropsis* and *Gossea* have been placed among the Olindiadae, and so have the following additional genera, *Gonionemus*, *Gonionemoides*, and *Vallentinia*. The structure of the tentacles has been used as the principal character of the genera belonging to the Olindiadae.

A new genus, *Amphogona*, has been instituted for *Pantachogon apsteini* of Vanhöffen. This medusa is bisexual, having male and female reproductive organs on alternating radial canals. I believe this to be the first recorded case of hermaphroditism amongst the Craspedote medusae. The new genus has been placed with the Aglauridae, but it also possesses characters of the Trachynemidae and looks like a connecting link between the two families.

Order ANTHOMEDUSAE.

Family **Williadae**, Forbes, 1848.

Character of the family. Anthomedusae with 4, 6 or more radial canals, each having one or more lateral branches (except in the earliest stage) running to the margin of the umbrella. Stomach with 4, 6 or more lobes, upon which the gonads are situated. Mouth with four or more lips, or with a folded margin. Tentacles simple, evenly distributed (not arranged in groups) round the margin of the umbrella.

The Williadae were classified by L. Agassiz (1862) as a family belonging to the Tubulariae (Gymnoblastea-Anthomedusae), but Haeckel (1879) removed the family to the Leptomedusae. He considered the gonads to be upon the radial canals and not upon the stomach. In 1893 I succeeded in connecting *Willia stellata*, Forbes, with the Gymnoblastic hydroid *Lar sabellarum*, Gosse, and cut a series of sections which showed that the gonads were upon the stomach and its lobes.

Haeckel placed the Williadae as a subfamily of the Cannotidae, and used the mode of branching of the canal system as the basis for classification. He introduced two new genera, namely, *Dyscannota* and *Willetta*, on the supposition that A. Agassiz had wrongly identified his specimens. It appears to me that the number of main radial canals is of greater importance than the mode of branching of the canal system and should be used for the generic character. The mode of branching, which carries with it the number of tentacles, would be of more value as a specific character.

The development of the radial canal system shows that the earliest free-swimming stage has unbranched canals. A young *Proboscidactyla* has four radial canals, without branches, and four tentacles. A young *Willia* has six unbranched radial canals and six tentacles. The branching of the canals appears later and passes through a definite series of stages.

A single abnormal specimen in the Maldive Collection, belonging to the Williadae, led me to investigate the literature relating to all the species and I have now attempted to make a revision of the family.

The Absence of a Circular Canal. Brandt (1838) in his description of *Proboscidactyla flavicirrata* states that a circular canal was not observed, but a very definite inner marginal edge was visible. When I was examining specimens of *Willia mutabilis* I noticed that what then was regarded by me as the circular canal was very slender and inconspicuous compared with the radial canals. As I could not make out a definite canal with the microscope a series of sections was cut. The sections showed a solid chord of cells without any opening in the centre. Sections were also cut of *Willia stellata* and these failed to show a circular canal. I have also examined *Willia stellata* alive when an active circulation was going on in the radial canals and inside the basal bulbs of the tentacles, but I did not see a circulation round the margin of the umbrella. Externally the solid chord of cells looks like a circular canal and expecting one to be present it is easy to mistake it for a canal. As every tentacle is in direct communication with the radial canals, the circular canal became functionless and it has now ceased to exist.

The Clusters of Nematocysts on the Ex-umbrella. In several species the nematocysts on the ex-umbrella have been carefully described, and it has been shown that their arrangement is a definite one. Radial clusters of nematocysts, situated midway between every two tentacles, extend from near the margin of the umbrella to about halfway or nearly to the top of the umbrella. The clusters are connected with one another by a kind of canal (just under the surface of the ex-umbrella), along which the nematocysts travel. An investigation of the nematocysts in *Willia stellata* when alive showed that isolated nematocysts travelled along the margin of the umbrella, then entered a canal, and after proceeding a short distance stopped. A cluster is formed by the accumulation of nematocysts. I could not find a cluster of nematocysts on the very margin of the umbrella, but always isolated nematocysts; the first cluster being at a little distance from the margin. In the earliest free-swimming stage there is only a single cluster between every two tentacles and as the umbrella increases in size other clusters are formed. The number of nematocysts in a cluster, the shape of the cluster, and the number of clusters in each row, I found to be very variable in the adult of *Willia stellata*.

Genus *Proboscidactyla*, Brandt, 1835.

Generic Character. Williadae with four radial canals leaving the stomach.

Proboscidactyla flavicirrata Brandt, 1835.

Proboscidactyla flavicirrata, Brandt (1835); Brandt (1838, p. 390, Taf. XIX.); Lesson (1843); L. Agassiz (1862); A. Agassiz (1865, p. 173, figs. 280—282); Haeckel (1879); *Proboscidactyla brevicirrata*, Haeckel (1879, p. 160); Murbach and Shearer (1902), (1903, p. 178).

The description of this species by Brandt and in addition the figures drawn from life by Mertens show that the main radial canals have two principal branches (a wide bifurcation), which run to the margin of the umbrella. From the inner side of each of the principal branches a number of branchlets run to the margin and the branchlets again branch near the margin. Mertens' figures show that a main canal has 18 branches which are in connection with 18 tentacles. The medusa should have altogether about 72 tentacles, a number far in excess of those of any other described species of the family.

A. Agassiz figures the same type of radial canal system for specimens taken on the American side of the Pacific Ocean. He records the presence of clusters of nematocysts on the ex-umbrella. Haeckel, however, considered that Agassiz's specimens were specifically distinct from those described by Brandt and gave to them a new specific name—*P. brevicirrata.* Murbach and Shearer have given a description, without figures, which practically confirms Agassiz's observations.

The specimens which have been described by the above authors had all reached the adult stage, but not quite the same stage in growth. Murbach records 54 tentacles for the largest specimen, Agassiz gives 64 tentacles, and Mertens' figures show about 70 tentacles. The early and intermediate stages of this species have not yet been recorded.

Distribution. North Pacific: Kamchatka (Mertens, *vide* Brandt). British Columbia: Gulf of Georgia (A. Agassiz). British Columbia: Victoria Harbour (Shearer).

Proboscidactyla occidentalis (Fewkes), 1889.

Willia occidentalis, Fewkes (1889, p. 109, Pl. V, fig. 3).

The four main radial canals run straight to the margin of the umbrella, and each canal gives off two opposite lateral branches, which again branch. Each main canal has therefore five terminations leading direct into five tentacles. A single cluster of nematocysts lies on the ex-umbrella between every two tentacles. Fewkes states that the "ovaries are four in number, arranged at the base of a four-parted stomach." The medusa has twenty tentacles, with bright reddish basal bulbs.

Distribution. North Pacific: California; Santa Cruz Is. (Fewkes).

Proboscidactyla ornata (McCrady), 1858.

Willsia ornata, McCrady (1858, p. 149, Pl. IX.); L. Agassiz (1862); A. Agassiz (1865, p. 171, figs. 274 *a*—279). *Dyscannota dysdipleura,* Haeckel (1879). *Willetta ornata,* Haeckel (1879). *Willia ornata,* Fewkes (1882, p. 299, figs. 22—23).

In the earliest free-swimming stage the medusa has four main radial canals, without any branches, and four tentacles (Fewkes, 1882). Agassiz (1865) has figured the intermediate stages showing that each main radial canal gives off a branch which runs to the margin of the umbrella. Later on a second branch appears on the side opposite to the first branch, and this also goes to the margin. McCrady (1858) described the adult stage with four main radial canals, each with three terminal branches and sixteen tentacles. Owing to the growth of the umbrella during the development of the canal system the main canals become curved and in the adult the appearance of the system is correctly expressed by saying that each main canal is twice dichotomously branched. The development of the canal system in this species is similar to that of *Willia stellata,* and can be conveniently separated into four stages.

First stage. Four radial canals without branches. 4 tentacles.

Second stage. Each main canal with one branch. 8 tentacles.

Third stage. Each main canal with two opposite branches. 12 tentacles.

Fourth stage. Each main canal with three branches. 16 tentacles.

Haeckel's classification of the family Cannotidae is primarily based upon the branching of the radial canal system, and secondarily upon the number of main radial canals from the stomach and the position of the gonads. The genera of this family have become somewhat complicated, as both Anthomedusae and Leptomedusae have been mingled together. Haeckel placed *Willia ornata*, McCrady (non Agassiz) in a new genus—*Willetta*, belonging to the sub-family Williadae. *Willia ornata*, A. Agassiz (non McCrady) is given a new generic and a new specific name, *Dyscannota dysdipleura*, and placed in the sub-family Berenicidae. Haeckel did not recognise the fact that Agassiz was describing the early and intermediate stages, showing the development of the canal system.

Distribution. North Atlantic: United States; South Carolina (McCrady). Massachusetts (A. Agassiz). Rhode Island (Fewkes), (Brooks).

Proboscidactyla gemmifera (Fewkes), 1882.

Willia ornata, Brooks (non McCrady), (1880); Brooks (1882). *Willia gemmifera*, Fewkes (1882, p. 300, Pl. I.). *Dyscannota gemmifera*, Mayer (1900, p. 47, Pl. VIII.).

When Brooks first found this species with medusa-buds he considered it to be a stage in the life-history of *Willia ornata*, McCrady. Fewkes succeeded in finding the first stage of *Willia ornata*, McCrady, and reared it up to the adult without seeing medusa-buds, and, as Agassiz had also described the early and intermediate stages without medusa-buds, Fewkes considered Brooks's medusa-budding *Willia* to be a distinct species and proposed for it a new specific name. Mayer fortunately found some specimens and has described them with excellent figures. He has adopted Haeckel's system of classification, hence the generic name *Dyscannota*. Mayer's figure shows that the medusa-bud, still attached to its parent, but ready for liberation, has four radial canals, without branches, and four tentacles. The parent medusa has two branches to each main canal, and twelve tentacles. Brooks's specimen belonged to an earlier stage, having only one branch to each canal, and eight tentacles.

The medusa-buds are upon stolons which hang down inside the cavity of the umbrella. The stolons are situated on the radial canals at their juncture with the stomach, one stolon on each of the four canals, and have at their free ends medusa-buds.

Distribution. North Atlantic: United States; North Carolina (Brooks). Tropical Atlantic: off Florida; in the Gulf Stream (Mayer).

Proboscidactyla tropica, species nova.

Willsia sp. Huxley (1877, p. 120, fig. 17).

This medusa has, up to the present, escaped having a specific name, and although figured and partly described in the well-known textbook, "A Manual of the Anatomy of Invertebrate Animals," it was omitted by Haeckel in his Monograph. Huxley's description is as follows:

"In August 1849, while in the North Pacific, off the Louisiade Archipelago, I took a species of *Willsia*, in which stolons were developed at the bifurcations of each of the four principal radiating canals of the nectocalyx. Each stolon was terminated by a knobbed extremity containing many nematocysts and gave rise, on one side, to a series of buds, of which those nearest the free end of the stolon had acquired the form of a complete medusoid. They

had four unbranched radiating canals and four tentacles; but it is probable that they would assume the form of the parent stock after development."

With the aid of the figures I have been able to draw up a description of the species and by bestowing upon it a specific name may prevent it from becoming lost again.

Description. Umbrella hemispherical, with a slight apical projection. Stomach short. Four main radial canals, each with three branches, all going to the margin of the umbrella. A stolon bearing medusa-buds hangs from each main canal at its junction with its first branch, and has at the free end a cluster of nematocysts. Sixteen short marginal tentacles, in direct communication with the radial canals. Size and colour not recorded.

Distribution. Tropical Pacific: Australasia; Louisiade Islands (Huxley).

Proboscidactyla varians, species nova (Pl. LIV. figs. 1, 2).

The collection contains only a single specimen, and though in a good state of preservation, yet it is badly contracted and has lost its natural shape. It is regarded by me as an abnormal specimen.

Description. Umbrella a little broader than high. Stomach with six lobes. Six radial canals, each with one to three lateral branches. Circular canal absent. Medusa-buds upon the radial canals, close to the stomach. Sixteen or more tentacles, with large triangular basal bulbs. Clusters of nematocysts on the ex-umbrella, arranged in radial rows.

Colour. Basal bulbs of the tentacles dark brown (in formalin).

Size. Umbrella 3 mm. in width and 2 mm. in length.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

If this solitary specimen had possessed no medusa-buds I should have placed it in the genus *Willia*, on account of its possessing six main radial canals. The medusa-buds show only four basal bulbs, with tentacles just beginning to develop, and there is not the slightest trace of any more bulbs. The fully developed medusa-buds of *Proboscidactyla tropica* and *gemmifera* have four main radial canals and four tentacles. The earliest free-swimming stage of *Proboscidactyla ornata* has also four main radial canals and four tentacles. But the earliest stage of *Willia stellata* has six main canals and six tentacles. The medusa-buds of this specimen indicate that it belongs to the genus *Proboscidactyla* and not to the genus *Willia*.

The parent medusa has six main radial canals with a variable number of lateral branches, and the lobes of the stomach show a want of symmetry. *Willia stellata* frequently shows a variation in the number of radial canals and in the number of lateral branches. As a rule when the number of main canals is above the normal number, then the branching of the canals is irregular. It will be seen in the figure that the abnormality of this specimen occurs in one quadrant, where three adjacent canals leave the stomach, each having only one lateral branch. These occupy the place of a main canal with four terminations on the margin of the umbrella. In a normal specimen at this stage, I consider that there should be a stomach with four lobes, four main radial canals, each twice dichotomously branched, sixteen tentacles. The specimen has only two medusa-buds, each of which is situated on a main radial canal, adjacent to the stomach. There is no stolon with a series of medusa-buds as found in *P. tropica* and *P. gemmifera*. The basal bulbs of the tentacles (fig. 2) are large and extend

into the substance of the umbrella, and the brown pigment of the bulbs is extended along some of the canals. Inside the margin of the umbrella there is a circular band of endoderm cells, but no circular canal can be seen. The groups of nematocysts extend over the ex-umbrella from near the margin to the top of the umbrella and are arranged in radial rows, one row between every two tentacles. In each row there are about six to seven circular clusters of nematocysts. Near the margin of the umbrella the canal along which the nematocysts travel is present, but it is only visible for a short distance.

Psythia prolifera, Agassiz and Mayer (1902, p. 143, Pl. I.). The authors, in placing the new genus in the family Williadae make the following statement: "In all previously known genera of the family Williadae the radial canals are branched. The general form, colour, shape of proboscis, and method of budding of the present medusa, however, all incline one to place it among the Williadae. It may be a primitive, or ancestral, form in which the canals have remained simple, or possibly an atavistic sport from some of the more complex Williadae, or an immature individual which may give rise to medusa-buds before attaining its complete development." A single specimen was found at the Tortugas, in the Gulf Stream off Florida. The medusa has four radial canals without branches; four tentacles with basal bulbs without any pigment; four perradial stolons bearing medusa-buds on the side of the stomach. There are no clusters of nematocysts on the ex-umbrella, but the medusa-bud has a few scattered nematocysts on the ex-umbrella, and they are absent in the parent medusa. It is like the first stage of *Proboscidactyla gemmifera* in possessing four radial canals, four tentacles, and stolons bearing medusa-buds. But the stolons are upon the stomach and not upon the radial canals, as in the other medusa-budding Williadae. The peculiar clusters of nematocysts are absent and also the pigment in the basal bulbs of the tentacles. The presence of medusa-buds and the absence of gonads indicate that the medusa is an early stage, but there is no conclusive evidence that it belongs to the Williadae.

Genus *Willia*, Forbes, 1846.

Generic Character. Williadae with six radial canals leaving the stomach.

Willia stellata Forbes, 1846.

Medusoid form.

Willsia stellata, Forbes (1846), (1848, p. 19, Pl. I.); Gosse (1853, p. 359, Pl. XX.); *Willia stellata*, L. Agassiz (1862); Haeckel (1879); *Willsia cornubica*, Peach (1867, p. 357, Pl. I.); *Lar sabellarum*, Browne (1896, p. 468, Pl. XVI.); (1898, p. 818, figs. 1—9).

Hydroid form.

Lar sabellarum, Gosse (1857, p. 113, Pl. XX.); Hincks (1872, p. 313, Pl. XIX.); Allman (1872).

Distribution. North Atlantic; British Isles.

Willia mutabilis Browne, 1902.

Willia mutabilis, Browne (1902, p. 280).

Distribution. South Atlantic; Falkland Islands (Vallentin).

Willia furcata, Haeckel (1879, p. 158). There is no figure published of this species, but the description shows that, if it is not identical with *Willia stellata*, it comes very close to it.

Distribution. North Atlantic; France (Haeckel).

Order LEPTOMEDUSAE.

Family **Eucopidae**, Gegenbaur, 1856.

Genus *Phialidium*, Leuckart, 1856.

Generic Character. Eucopidae with many marginal sensory vesicles; one or more between every two tentacles, each having a single otolith. Many tentacles. No marginal cirri. A gonad on each of the four radial canals. Stomach not on a peduncle.

Phialidium tenue, species nova. (Pl. LIV. fig. 4, Pl. LVII. fig. 16.)

Description. Umbrella watch-glass-shaped and thin. Stomach small, quadrangular in shape, and situated on a semi-globular thickening of the umbrella. Mouth with four lips and a sinuous margin. Four gonads extending over the outer half of each radial canal. Tentacles 25 in number. One or two minute marginal bulbs between every two tentacles. Sense organs numerous, one or two (rarely three) between every two tentacles, with a single otolith.

Size. Diameter of the umbrella 15 mm.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

There is only one specimen in the collection. The semi-globular thickening of the umbrella upon which the stomach is situated cannot be regarded as a true peduncle; it is simply a thickening of the wall of the umbrella. The tentacles are thin and slender with transverse rows of nematocysts. Their basal bulbs are a little broader than long; one measured 0·45 mm. in width, 0·33 mm. in length. The specimen closely resembles *Phialidium temporarium*, Browne, one of the commonest medusae in the British seas. It differs in the shape and size of the basal bulbs of the tentacles, being broader and about twice the size. The umbrella is a little thicker and the semi-globular mass of jelly at the top of the sub-umbrella cavity is very much larger. In *Phialidium temporarium* this thickening is often absent and never very conspicuous.

Genus *Pseudoclytia*, Mayer, 1900.

Generic Character. Eucopidae with many marginal sensory vesicles; one or more between every two tentacles, each having a single otolith. No marginal cirri. Five radial canals, each with a single gonad. Stomach not on a peduncle.

Mayer established the genus *Pseudoclytia* for a new species (*P. pentata*), which he found in great abundance at the Tortugas, off Florida, U.S.A. This species is pentamerous, possessing five radial canals, five gonads, and a mouth with five lips. Among 1000 individuals Mayer found 70·3 p.c. to be pentamerous with radial canals at equal distances apart. Hitherto among the Eucopidae four radial canals were always regarded as the normal number and any

numerical change was the sign of a variation from the normal type. The British Eucopidae very rarely show a numerical variation in the radial canals. There can be but little doubt that this pentamerous species has arisen from a *Phialidium*-like medusa, which had four radial canals, four gonads, and a mouth with four lips.

In the Maldive collection there are two specimens belonging to the Eucopidae, with five radial canals. If Mayer had not instituted the genus *Pseudoclytia*, the species would have been placed in the genus *Phialidium* and regarded as a variation from the normal type. I think, on the whole, it will be best to place this new species in the genus *Pseudoclytia*. The two specimens are practically identical, and the chances of catching two abnormal *Phialidium* exactly alike are very remote so far as my experience goes.

Pseudoclytia gardineri, species nova. (Pl. LV. figs. 1—3.)

Description of the Species. Umbrella broader than high (? watch-glass-shaped). Stomach short with a pentagonal base. Mouth with five small lips. Five radial canals (four nearly at right angles and one in between). Gonads very small (globular in the female and oval in the male), one situated on each radial canal about midway between the stomach and the margin. About 13—14 tentacles, with globular basal bulbs. Usually one or two marginal bulbs between every two tentacles, except in one segment where there is a conspicuous group of six bulbs (three on each side of a tentacle). Sense organs numerous, usually two or three between every two tentacles, with probably one otolith.

Size. Diameter of the umbrella about 5 mm.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

Neither of the specimens is in very good condition, so that the exact shape of the umbrella is doubtful, but it seems fairly thin and without a thick mass of jelly over the cavity of the umbrella. The mouth of one specimen is closed, and it has five distinct lips; in the other specimen it is expanded and has a quadrangular aperture with a sinuous margin. The ovaries are very small, globular in shape and containing about four to six ova. The gonads of the male are a little nearer the margin of the umbrella than those of the female. The characteristic feature of this species and that upon which the specific character is based is the group of six large marginal bulbs adjacent to one of the tentacles. This group is very conspicuous on the margin of the umbrella and is at once seen. The tentacle is in the centre of the group (fig. 3), and has three bulbs on each side. A marginal sense organ lies between each of the outer two bulbs, but there is not one next the tentacle. On the inner side of the circular canal a series of bays exists, corresponding in position to the bulbs and tentacles. In the male specimen (fig. 1) there are indications of two more groups of bulbs being formed, each with two bulbs on either side of a tentacle.

It is a pleasure to me to associate this new species with the name of Mr J. Stanley Gardiner.

Family **Aequoridae**, Eschscholtz, 1829.

Genus *Aequorea*, Péron et Lesueur, 1809.

Generic Character. Aequoridae with numerous simple unbranched radial canals. Stomach circular, with the lower wall fully developed. Mouth capable of closing up.

The type species of the genus *Aequorea* was described and figured by Forskål (1775), under the name of *Medusa aequorea*. Péron placed it in the genus *Aequorea* under the name of *Aequorea forskålea*, where it has since remained. There will always be some doubt about the identity of the type species, as the figure and description omit just the details which are essential. I think it will be best to follow Forbes (1851) and consider the medusa, which he described and figured as *Aequorea forskålea*, to be identical with the type species.

The shape of the basal bulbs of the tentacles is a valuable guide for the determination of the species. I have found it to be quite different in six species of the Aequoridae. As the shape is constant in each species it facilitates the identification of the early and intermediate stages.

Aequorea maldivensis, species nova. (Pl. LVI. figs. 4—12.)

Description of the Species. Umbrella saucer-shaped, about four to six times as broad as high, moderately thick. Stomach circular, its diameter about half the diameter of the umbrella, its lower wall large enough to allow the mouth to close up. Mouth with numerous short lips, closely packed together. Radial canals numerous (50—70). Gonads occupying nearly the whole length of every radial canal, and hanging down from the sub-umbrella, bilamellar. Tentacles less numerous (30—50) than the radial canals, having a large hollow basal bulb, which curls over a thickening of the ex-umbrella. Marginal bulbs about one to four between every two tentacles. Sense organs very numerous, about 15—20 between every two tentacles (or 2—4 between every two bulbs).

Size. Umbrella 75 mm. in width and 35 mm. in height (largest specimen).

Distribution. Indian Ocean; Maldive Islands, Haddumati (Gardiner).

The collection contains three specimens:

A. Umbrella about 35 mm. in diameter and about six times as broad as high. Stomach about 20 mm. in diameter. Radial canals, 52. Tentacles, 21. Marginal bulbs, usually one large and 2—4 smaller ones between every two tentacles. Sense organs, 16—24 between every two tentacles (or 2—4 between every two bulbs). Female gonads.

B. Umbrella about 45 mm. in diameter and about five times as broad as high. Stomach about 23 mm. in diameter, its lower wall fairly flat and the mouth nearly closed. Mouth circular, 6 mm. in diameter, and the margin with about 54 lips. Radial canals, 69. Tentacles, 34. Marginal bulbs, usually one large and two small bulbs between every two tentacles. Sense organs, 12—14 between every two tentacles. Male gonads.

C. Umbrella about 75 mm. in diameter and about four times as broad as high. Stomach about 35 mm. in diameter. Radial canals, 54. Tentacles, 50. Marginal bulbs, usually one between every two tentacles. Sense organs, 15—20 between every two tentacles. Female gonads.

The lower wall of the stomach varies in width in the different specimens. In one specimen the mouth is certainly capable of closing up. In the other two specimens the mouth appears to be fairly wide open, but its exact size is doubtful, as the wall of the stomach is torn away in places. The oral lips (figs. 8—9) are short and stumpy, with a sinuous margin. A longitudinal rib runs down the outer side of each lip and on the inner side there is a groove. The radial canals are deeper than they are broad, and hang down from the sub-

umbrella. The gonads (fig. 6) extend along nearly the whole length of the radial canals, leaving both ends free. In the male the portion of the canals bearing the gonads is more tubular than in the female. In the female (fig. 7) the gonads hang down from the wall of the sub-umbrella and are distinctly bilamellar.

The basal bulbs of the tentacles (figs. 10—12) are broad hollow sacs and are characterized by curling over a thickening of the margin of the umbrella. There is an excretory pore opening from the circular canal opposite each of the basal bulbs of the tentacles and each of the largest marginal bulbs. The marginal bulbs also curl over the margin of the umbrella and some of them probably develop tentacles at a later stage in the growth of the medusa. The sensory vesicles are very minute; their otoliths are not visible.

Genus *Mesonema*, Eschscholtz, 1829.

Aequoridae with numerous simple, unbranched radial canals. Stomach circular, with lower wall quite rudimentary. Mouth nearly as large as the diameter of the stomach and cannot be closed.

Mesonema pensile (Modeer), 1791. (Pl. LV. fig. 4, Pl. LVII. figs. 2—9.)

Medusa, sp. Forskål (1776, p. 9, Tab. XXVIII. fig. *B*); *Medusa coelum pensile*, Modeer (1791, p. 32); *Aequorea mesonema*, Péron (1809); *Mesonema coelum pensile*, Eschscholtz (1829); *Mesonema pensile*, Haeckel (1879).

In Forskål's *Icones rerum naturalium*, 1776, there is a good figure of a medusa about which nothing is stated, except in the description of the figure. There occurs this very brief statement, "*Medusa non descripta.* Color coerulescens."

Modeer gave a short description of the medusa from Forskål's figure, and called it *Medusa coelum pensile.* Péron placed the species in a new genus under the name of *Aequorea mesonema.* Eschscholtz removed it from the genus *Aequorea* to the genus *Mesonema* and restored Modeer's specific name. These early authors suggested the locality for Forskål's medusa to be in the Mediterranean, but it must be remembered that Forskål did not state where he found his specimen, and that his book contains the descriptions of the animals which he found in the Red Sea, as well as in the Mediterranean.

Haeckel adopted the name *Mesonema pensile* for Forskål's medusa, but he gives among the synonyms *Mesonema coerulescens*, Kölliker, 1853, and *Stomobrachium mirabile*, Kölliker, 1853; both taken by Kölliker in the Mediterranean. I fail to see the connection between Forskål's medusa and Kölliker's two species. These are young and intermediate stages, probably belonging to the genus *Aequorea.* Haeckel's description of *Mesonema pensile* is based upon the description of three species, and consequently is of little value.

In the Maldive collection there are four medusae which have all the characters of the medusa figured by Forskål.

Description of the Species. Umbrella almost a solid mass of jelly, rather like a plano-convex lens in shape, about twice to three times as broad as high. Sub-umbrella forming only a fringe round the periphery. Stomach completely rudimentary, its lower wall about 2 mm. in length, and its diameter about two-thirds the diameter of the umbrella. Mouth circular, nearly as large as the diameter of the stomach; non-contractile, and always wide

open; its margin furnished with a large number of long narrow lips, which are strengthened by an external rib. Radial canals about 100—150 in number, very short. Gonads upon all the radial canals, extending nearly from the stomach to within a short distance of the circular canal. Tentacles about 10—15, with basal bulbs having a long lateral extension along the margin of the umbrella. Numerous marginal bulbs, closely packed together, about two to three between every two radial canals. Marginal sense organs very numerous, about two to four between every two marginal bulbs.

Size. Umbrella about 60 mm. in length and about 30 mm. in height.

Distribution. Indian Ocean, Maldive Is., Haddumati and Goifurfehendu (Gardiner).

The collection contains four specimens:

A. Umbrella 45 mm. in width and 20 mm. in height. Stomach 26 mm. in diameter. Radial canals about 120. Tentacles, 10. Marginal bulbs about 12 between every two tentacles.

B. Umbrella about 60 mm. in width and 25 mm. in height. Radial canals about 100. Tentacles 10, perhaps more. This specimen is in bad condition; the margin of the umbrella damaged and the mouth torn away.

C. Umbrella about 60 mm. in width and 30 mm. in height. Radial canals estimated at 150. Tentacles 15. The specimen is in bad condition.

D. Umbrella about 60 mm. in width and about 20 mm. in height. Mouth 43 mm. in diameter. Radial canals about 148, their length about 10 mm. Tentacles 13.

The thickness of the umbrella (fig. 2) is so great that the sub-umbrella cavity is reduced to a mere shallow depression round the margin of the umbrella. The oral lips (fig. 9) are long and thin, about 3 mm. in length, without a sinuous margin. On the external side of every lip there is a longitudinal rib, which extends into the wall of the stomach, and on the inner side a corresponding groove. There are about as many oral lips as radial canals. The gonads (fig. 4) are situated on both sides of every radial canal and do not hang down in bands or folds. The tentacles are few in number and are not arranged at equal distances apart. Their basal bulbs (figs. 6—8) have long lateral extensions along the margin of the umbrella. The marginal bulbs (fig. 5) are very minute and have at their apex a circular cluster of nematocysts.

In my account of *Aequorea norvegica* (1903) I made the following statement: "The exact shape of the stomach and whether the mouth is open or closed are scarcely suitable for generic characters. The fact that an Aequorid is occasionally caught with its mouth open is no evidence that it is permanently kept open." This statement must now be modified. It referred to the genera *Aequorea* and *Polycanna* and with them it probably holds good, as neither has a rudimentary stomach. All the species of the Aequoridae, which I had then seen, possessed a mouth capable of closing up, but since I have seen these Maldive specimens my statement about the exact shape of the stomach for a generic character becomes untenable.

The stomach is quite rudimentary and is practically absent, as its lower wall is only about 2 mm. in length, so that the mouth must always remain wide open. It appears to me that the function of the stomach has been removed to the canal system. The medusa probably lives upon organisms of microscopic dimensions, such as unicellular algae and protozoa, which are picked up by the endoderm cells lining the canal system. The water containing these organisms, after circulating in the canal system, probably passes out through the numerous

pores on the circular canal. The Aequoridae which have a large funnel-shaped stomach and a closeable mouth may also have the radial canals functioning as digestive organs. The contraction of the stomach, when the mouth is closed, would drive water into the canal system and expel the stale water through the pores on the circular canal. The hypothesis that the radial canals function as the digestive organs would perhaps account for the large number usually present in the Aequoridae, some of which are the largest Leptomedusae known.

Order TRACHOMEDUSAE.

Family **Petasidae**, Haeckel, 1877.

Family Character. Trachomedusae with four radial canals, upon which are situated cylindrical, globular, or papilliform gonads. Stomach without a peduncle. Either external sensory clubs, or external or internal sensory vesicles.

Haeckel (1879) divided the Petasidae into two subfamilies, namely:

Petnachnidae, without blind centripetal canals. Genera: *Petasus, Dipetasus, Petasata, Petachnum, Aglauropsis* and *Gossea.*

Olindiadae, with blind centripetal canals. Genus: *Olindias.*

Since Haeckel published his *System der Medusen* three more genera must be added to the family, namely, *Gonionemus* (placed by Haeckel among the Thaumantidae under a wrongly spelt generic name *Gonynema*), *Gonionemoides* and *Vallentinia.*

A more natural classification of the Petasidae can, I think, be obtained by taking the structure of the sense organs instead of the centripetal canals for the characters of the two subfamilies.

There are two distinct types of sense organs:

A. *Sensory clubs* (Hörkölbchen) with a short stalk, which project from the margin of the umbrella; with a single otolith and with external sensory hairs. These sensory clubs are present in the genera *Petasus, Diptasus, Petasata, Petnachnum*? (species not figured).

B. *Sensory vesicles* (Hörbläschen) situated either in the mesogloea (internal) or on the margin of the umbrella (external); sessile and without external sensory hairs. These sensory vesicles are present in the genera *Aglauropsis, Gossea, Olindias, Gonionemus, Gonionemoides* and *Vallentinia.*

On this classification the arrangement of the genera would be as follows:

Subfamily **Petachnidae,** Haeckel, 1877.

Petasidae with sensory clubs containing an otolith and with external sensory hairs.

Genus *Petasus.* Species—*P. atavus, P. tetranema.*

Genus *Dipetasus.* Species—*D. digonimus.*

Genus *Petasata.* Species—*P. eucope.*

Genus ?*Petachnum.* Species—*P. tiaropsis.*

All the above genera and species were described by Haeckel (1879), and I have not succeeded in finding any notice of their being recorded by any other person.

Subfamily **Olindiadae,** Haeckel, 1877.

Petasidae with sensory vesicles situated either in the substance of the umbrella (internal), or on the margin of the umbrella (external); sessile, and without external sensory hairs.

Genus *Aglauropsis,* F. Müller, 1865.

Generic Character. Petasidae with numerous uniform tentacles, without adhesive disks, and not arranged in groups.

A. agassizii, Müller, 1865. South Atlantic; Brazil.

A. conantii, Browne, 1903. South Atlantic; Falkland Is.

Müller's description of *Aglauropsis agassizii* is very incomplete, in fact, he only gives generic characters. The specific name should either be attached to the next *Aglauropsis* found on the coast of Brazil, or else placed on the obsolete list.

Maeotias inexpectata, Ostroumoff, 1896. Ostroumoff has published a brief preliminary Latin description of this genus and species in the *Zool. Anzeiger,* 1896, and a full description with figures, in the *Bulletin of the Imperial Academy of Sciences of St Petersburg,* 1896. Unfortunately the text of the latter publication is wholly in Russian, and the chief figure is rendered useless by the tentacles being represented merely by a series of closely ruled lines. Ostroumoff points out that the genus differs from *Olindias* in possessing only flexible tentacles, which all hang down from the margin of the umbrella. There are about 300 hollow flexible tentacles, about 100 marginal bulbs, about 200 internal sense organs arranged in pairs, about 13 to 15 centripetal canals in each quadrant, and gonads along nearly the whole length of the radial canals. Distribution. Europe; Sea of Azov. As I am uncertain about the structure of the tentacles I have not included this species in the genus *Aglauropsis,* as it may perchance belong to one of the other genera.

Genus *Gossea,* L. Agassiz, 1862.

Generic Character. Petasidae with uniform tentacles arranged in eight groups (four perradial and four interradial) and a few small isolated tentacles between the groups.

G. corynetes (Gosse), 1853. North Atlantic, British Isles. Syn. *G. circinata,* Haeckel, 1879. North Atlantic; France.

Genus *Olindias* F. Müller, 1861.

Generic Character. Petasidae with numerous tentacles, of which there are two distinct kinds. A series (primary) of short stiff tentacles, which are carried outwards and have their bases attached to the ex-umbrella; and a series (secondary) of long flexible tentacles, which hang downwards from the margin of the umbrella. No adhesive disks on any of the tentacles.

O. sambaquiensis, Müller, 1861. South Atlantic; Brazil.

O. mülleri, Haeckel, 1879. Mediterranean.

O. tenuis (Mayer), 1900. Tropical Atlantic; Florida. Syn. *Halicalyx tenuis*, Mayer (1900, p. 63, Pls. V.—VI.). ?*Halicalyx tenuis*, Fewkes (1882, p. 277, Pl. VII.).

There is a disagreement in the descriptions given by Fewkes and by Mayer of *Halicalyx tenuis*. Fewkes states that the medusa has twelve tentacles, uniform in shape, with a single otolith at the base of each one. Mayer describes his specimens with two distinct kinds of tentacles and a pair of sense organs at the base of each primary tentacle, and also with many centripetal canals, which are not mentioned by Fewkes. Fewkes's specimen cannot be an early stage because the gonads are described and figured, though it may be an intermediate stage in growth. I can understand Fewkes's instituting a new genus for his species, because it does not agree with the generic character of *Olindias*, and at that date the genus *Aglauropsis* was very vaguely described on an incomplete description of a single species. It is just possible that Fewkes's specimen belongs to the genus *Aglauropsis*. Mayer's beautiful figures of *Halicalyx tenuis* show all the characters of an *Olindias*.

Olindias singularis, species nova. (Pl. LVI. fig. 2, Pl. LVII. fig. 1.)

Description. Umbrella hemispherical, with thick walls, about one and a half times as broad as high. Stomach about half as long as the cavity of the umbrella: mouth with four lips having a sinuous margin. Four radial canals: four to five blind centripetal canals in each quadrant. Gonads on the outer half of each radial canal, and separated into isolated papilliform clusters. Two kinds of tentacles; primary tentacles which are carried outwards and have their bases attached to the margin of the ex-umbrella, and secondary tentacles which hang downwards from the margin of the umbrella. About 7—10 primary tentacles and 4—5 secondary tentacles in each quadrant. About 8—10 globular marginal bulbs containing nematocysts in each quadrant. One internal sensory vesicle containing a single otolith at the base of each primary tentacle.

Size. Umbrella 13 mm. in width and 8 mm. in height.

Distribution. Indian Ocean: Maldive Is., Suvadiva (Gardiner).

The collection contains a single specimen in a good state of preservation. It mainly differs from the species hitherto described in possessing only one sense organ at the base of each primary tentacle, instead of a pair of sense organs. The possession of a pair of sense organs has been considered by Haeckel to be a part of the generic character. I think that the position of the sense organs, external or internal, and the number of sense organs had better not be included in the generic characters, but would be of more use for specific characters. Haeckel states that *Olindias mülleri* found in the Mediterranean has, in addition to the internal paired sensory vesicles, a series of club-shaped ocelli situated between the marginal bulbs. I have examined large adult specimens from Naples and have failed to find any ocelli.

In *Olindias singularis* the primary tentacles are curved outwards from the margin of the umbrella. Their bases are partly enclosed by an overgrowth of the ex-umbrella, to which they are attached for a short distance. These tentacles have either oblong or short spiral bands of nematocysts, and at their free end there is a claw-shaped termination, which has its margin closely packed with very long nematocysts. The secondary tentacles are hollow (like the primary ones) and hang down from the margin of the umbrella. They have a large basal bulb and numerous bands of nematocysts, forming about three-quarter circular

loops, but not meeting on the inner side. The marginal bulbs are large hollow balls in direct communication with the circular canal, and are externally covered with nematocysts.

Genus *Gonionemus*, A. Agassiz, 1862.

Generic Character. Petasidae with numerous uniform tentacles, each having an adhesive disk.

G. vertens, A. Agassiz, 1862. North Pacific; British Columbia.

G. suavaensis, Agassiz and Mayer, 1899. Tropical Pacific; Fiji.

G. aphrodite, Mayer, 1894 and 1900. Tropical Atlantic; Florida.

G. agassizii, Murbach and Shearer, 1903. North Pacific; Aleutian Is. and Japan (Kirkpatrick, 1903).

G. murbachii, Mayer, 1901. North Atlantic; Massach. U.S.A.

G. pelagicus, Bigelow, 1904. Indian Ocean; Maldive Is.

Genus *Gonionemoides*, Mayer, 1900.

Generic Character. Petasidae with numerous tentacles, of which there are two distinct kinds. A series (primary) with adhesive disks and another series (secondary) without adhesive disks and with more numerous and larger bands of nematocysts.

G. geophila, Mayer, 1900. Tropical Atlantic; Florida.

Genus *Vallentinia*, Browne, 1902.

Generic Character. Petasidae with two distinct kinds of tentacles. Four solid perradial tentacles with terminal suckers, and many hollow tentacles with bands of nematocysts, but without suckers.

V. falklandica, Browne, 1902. South Atlantic; Falkland Is.

Family **Geryonidae,** Eschscholtz, 1829.

Trachomedusae with four or six radial canals, in the course of which are situated leaf-shaped gonads. Blind centripetal canals. Stomach on a long peduncle. Internal sensory vesicles.

Genus *Liriope*, Lesson, 1843.

Generic Character. Geryonidae with four radial canals and with four or eight tentacles.

Liriope tetraphylla (Chamisso et Eysenhardt), 1820. (Pl. LIV. fig. 3.)

Geryonia tetraphylla, Chamisso et Eysenhardt (1820, p. 357, Pl. XXVII.). *Liriantha tetraphylla*, Haeckel (1879). *Liriope tetraphylla*, Vanhöffen (1902, p. 82, Taf. x.).

There is only one specimen in the collection, and a figure is given of it because I am not certain about the correctness of the identification. *Liriope tetraphylla* has, according to Vanhöffen, a very wide geographical distribution, as it was found by the "Valdivia" in the Atlantic, Indian Ocean, and the Red Sea. The specimens showed a considerable variation in the shape and size of the umbrella, in the length of the peduncle, and in the position and shape of the gonads; all of which have been used by other authors for specific characters.

Description of the specimen. Umbrella hemispherical, very thick, about twice as broad as high. Stomach on a cylindrical peduncle. Gonads rhomboidal, broader than long, on the distal half of the radial canals and extending nearly to the margin of the umbrella. The distance between the gonads about equal to their breadth. Four perradial tentacles. Three centripetal canals in each quadrant. Eight sense organs.

Size. Umbrella 7 mm. in width and 4½ mm. in height. Peduncle 3 mm. in length.

Locality. Indian Ocean; Maldive Is. (Gardiner).

Family **Aglauridae,** L. Agassiz, 1862.

Trachomedusae with eight radial canals, in the course of which are situated eight gonads. Stomach on a peduncle. Numerous uniform tentacles. Sense organs external and free.

Genus *Aglaura,* Péron et Lesueur, 1806.

Generic Character. Aglauridae with gonads situated upon the peduncle of the stomach.

Aglaura hemistoma, Péron et Lesueur, 1809.

Aglaura hemistoma, Gegenbaur (1856, p. 248, Taf. VII.); Haeckel (1879, p. 275, Taf. XVI.); Maas (1893, p. 25, Taf. I.); Mayer (1900, p. 65, Pl. XXV.); Vanhöffen (1902, p. 78).

The collection contains a single small specimen, which is not in very good condition. The shape of the umbrella is very much like that of the figures given by Haeckel and by Mayer.

Description. Umbrella with a short conical summit, about 2½ mm. in length and width. Stomach roundish, on a very short peduncle. Mouth with four lips. Eight sausage-shaped gonads, about 1 mm. in length, situated on the peduncle and adjacent to the stomach. Ova visible. Tentacles estimated at about 64. Sense organs not seen; the margin of the umbrella is damaged.

Distribution. In the warm waters of the Atlantic, Indian Ocean, and the Red Sea.

Amphogona, genus novum.

Generic Character. Aglauridae with gonads situated upon the sub-umbrella. Gonads bisexual. Umbrella much broader than high.

Amphogona apsteini (Vanhöffen), 1902. (Pl. LIV. fig. 5, Pl. LV. fig. 5, Pl. LVI. fig. 1, Pl. LVII. figs. 10—15.)

Pantachogon apsteini, Vanhöffen (1902, p. 65, Taf. x. fig. 18, Taf. xi. fig. 28).

The genus Pantachogon was instituted by Maas (1893) for a species (*P. haeckelii*) found in the North Atlantic. This medusa has a series of spindle-shaped gonads along nearly the whole length of the radial canals. The stomach is not situated upon a peduncle, and the genus belongs to the Trachynemidae. Vanhöffen has slightly altered Maas' original definition of the genus for the inclusion of his new species, *P. apsteini*, found on the west coast of Sumatra. This species has oval gonads near the margin of the umbrella, and the stomach is situated upon a distinct peduncle. It has the characters of the Aglauridae.

The specimens in this collection agree very closely with the description and figures of *Pantachogon apsteini*, and I believe that they belong to that species. According to the classification adopted by Haeckel, and by Maas, the Maldive specimens would belong to the genus *Agliscra*, as the eight gonads are upon the sub-umbrella. But in one respect, however, there is a considerable difference. The shape of the umbrella is unlike that of the Aglauridae, and is more like that of the Trachynemidae. In *Agliscra* the umbrella is about twice as high as broad, whereas in the Maldive specimens the umbrella is about two to three times as broad as high. If one imagined an *Agliscra* with its umbrella flattened out then it would resemble this species. I do not think that the Maldive specimens or Vanhöffen's specimens belong to the genus *Pantachogon* of Maas, as they are not like the type species, *P. haeckelii*. They show a nearer relationship to *Agliscra*. I think it is best to institute a new genus, to which I give the name *Amphogona* (*ἄμφω-γονή*) and place it in the family Aglauridae.

Specific Characters. Umbrella saucer-shaped, with thin walls, about twice to three times as broad as high. Velum fairly broad. Stomach small, situated on a short peduncle. Mouth with four thick lips. Eight radial canals. Eight globular or oval gonads, situated upon the radial canals near the margin of the umbrella; bisexual, male and female gonads upon alternating canals. About 70 or more tentacles, uniform in shape. Sense organs external, ?16.

Size. Umbrella $4\frac{1}{4}$ mm. in width and $1\frac{3}{4}$ mm. in length (the largest specimen).

Distribution. Indian Ocean; West coast of Sumatra (Vanhöffen); Maldive Islands, Miladumadulu (Gardiner).

The collection contains three specimens.

A. An intermediate stage. Umbrella $2\frac{1}{2}$ mm. in width and $1\frac{1}{2}$ mm. in height. Stomach a little longer than the peduncle, which measured 0·25 mm. Gonads just beginning to develop and varying slightly in size. About six tentacles and one sense organ in each octant.

B. An immature adult. Umbrella 4 mm. in width and $1\frac{1}{2}$ mm. in height. Stomach on a peduncle, which measured 0·6 mm. in length. Eight globular gonads, male and female on alternating canals, all about the same size and shape. Tentacles, 57. Sense organs, 10 (six octants with one sense organ and two octants with two sense organs).

C. An adult. Umbrella $4\frac{1}{4}$ mm. in width and $1\frac{3}{4}$ mm. in height. Stomach on a peduncle, which measured about 0·5 mm. in length, and twice as long as the stomach. Eight oval gonads, male and female on alternating canals. Tentacles, 74 (the following numbers in each

octant: 9, 10, 9, 9, 10, 9, 9, 9). Sense organs, 14 (the following numbers in each octant: 1, 1, 2, 2, 3, 1, 2, 2). In this specimen the gonads vary very much in size. Two pairs, male and female, oppositely situated and fully developed, are large; the other two pairs are very small.

Vanhöffen's figures show that the gonads are very unequal in size. Four are large and four are very small, looking as if they were just beginning to develop. The large and small gonads occur on alternating radial canals. Vanhöffen does not state the sex of the gonads, but the largest look immature in his figure. In the smallest Maldive specimen, much younger than Vanhöffen's specimens, the gonads are just beginning to develop. They vary slightly in size, showing that they have not all started to develop at the same time, but the sizes are not arranged in any definite order. In the second specimen the gonads are all about the same size and shape, but not quite fully developed. In the largest specimen there is a well-marked difference in the size of the gonads, which are arranged in pairs, male and female, two large and two small, so that the large and small are not upon alternating canals. The male and female gonads are always upon alternating canals, but in these specimens there is no evidence to show that one sex is in advance of the other, though the gonads are not all of a size.

The occurrence of both male and female gonads upon the same individual is the most interesting character of this species, for, so far as I know, hermaphroditism has not been hitherto recorded for any Craspedote medusa.

Order Narcomedusae.

Family **Aeginidae**, Gegenbaur, 1856.

Genus *Solmundella*, Haeckel, 1879.

Generic Character. Aeginidae with two tentacles and with a stomach having eight pouches.

Solmundella bitentaculata (Quoy et Gaimard) 1833. (Pl. LVI. fig. 3.)

Charybdea bitentaculata, Quoy et Gaimard (1833, Tom. iv. p. 295, Pl. xxv. figs. 4—5). *Aeginella bitentaculata*, Haeckel (1879).

Description. Umbrella somewhat cone-shaped, a little broader than high. Stomach circular, nearly as wide as the umbrella, having lateral pouches about twice as broad as high, containing the gonads. Four radial canals. Two opposite, non-contractile tentacles, which are situated above the stomach and are about three times longer than the diameter of the umbrella. Sixteen sense organs, each with a single otolith.

Size. Umbrella 3½ mm. in width and about 3 mm. in height.

Length of the tentacles about 6—10 mm.

Distribution. Indian Ocean; Maldive Islands, Minikoi (Gardiner, 3 Aug. 1899). Australasian Seas; Amboina Is. (Quoy et Gaimard).

Maas (1904) has just published a preliminary revision of the genera belonging to the Cunanthidae and Aeginidae, but a revision of their species is not given. Maas proposes to unite the genera *Aeginella* and *Solmundella*, and to transfer the latter genus from the Solmaridae to the Aeginidae. This classification I have adopted. (See p. 745.)

SIPHONOPHORA.

Order CALYCOPHORAE, Leuckart.

Family **Diphyidae**, Eschscholtz, 1829.

Genus *Diphyes*, Cuvier, 1817.

Generic Characters. Diphyidae with two angular, slenderly pyramidal nectophores, of similar form and subequal size, one placed behind the other. The first nectophore with a conical or campanulate hydroecium. Cormidia without special nectophores. Bracts pyramidal, conical or spathiform, with a pointed apex. Phyllocyst simple, usually large and ovate, without radial canals.

Diphyes chamissonis, Huxley, 1859. (Pl. LIV. fig. 6.)

Diphyes chamissonis, Huxley (1859, p. 36, Pl. I. fig. 3).

There are five anterior nectophores in the collection and as they are more like Huxley's figures of *Diphyes chamissonis* than any other species that I know of, I have placed them under this name.

Description of the Specimens. The nectophore is about 10—12 mm. in length, 4 mm. in width and 3 mm. in depth. It is a long slender pyramid, slightly more curved on the posterior side than on the anterior. The ex-umbrella has three prominent ridges without serrations; one anterior and two lateral which are situated over the nectosac. The posterior side of the ex-umbrella is flat. The shape of nectophore is not exactly like Huxley's figure; as it is not quite so broad and it tapers more towards the apex.

The nectosac is nearly as long as the umbrella, cylindrical and tapering towards its apex almost to a point. The nectocalycine canal runs a considerable distance down the hydroecium and enters the nectosac not far from its mouth. Here it joins a pair of radial canals which run up nearly to the top of the nectosac, then curve over and descend to the circular canal. There is also a short radial canal which runs down from the junction of the nectocalycine canal to the circular canal. The mouth of the nectosac is protected by three short triangular teeth, which have slightly serrated edges.

The hydroecium extends about half way up the umbrella. It is somewhat triangular in shape and has a conspicuous constriction near its mouth. At this point the aperture is nearly circular.

The somatocyst is cylindrical in shape and tapers down towards the hydroecium. One specimen has a small oval somatocyst, but in the other specimens the somatocyst is cylindrical and shows only a slight variation in length and shape. At the top of the somatocyst there is a small yellowish body, irregular in shape, which is probably the remains of an oleocyst.

The siphosome in nearly all the specimens is contracted within the hydroecium, but in one specimen it is more expanded, so that the cormidia are more easily seen. The eudoxomes have a spathiform bract, just like Huxley's figure in shape, a siphon and a contracted tentacle.

Distribution. Pacific Ocean; East coast of Australia, and the Louisiade Archipelago (Huxley). Indian Ocean; Maldive Is. Minikoi (Gardiner, 3rd Aug. 1899).

Genus *Diphyopsis*, Haeckel, 1888.

Generic Characters. Diphyidae with two angular, slenderly pyramidal nectophores of similar form and subequal size, one placed behind the other. First nectophore with a conical or campanulate hydroecium. Each cormidium with a special nectophore. Bracts pyramidal, conical or spathiform, with a pointed apex. Phyllocyst simple, ovate, without radial canals.

Diphyopsis campanulifera (Eschscholtz), 1829.

Diphyes campanulifera, Eschscholtz (1829, p. 137). *Diphyopsis compressa*, Haeckel (1888, p. 153, Pl. XXXIII.). *Diphyopsis campanulifera*, Chun (1897, p. 26). *Diphyopsis campanulifera*, Mayer (1900, p. 75, Pl. XXVIII.).

Sexual generation. *Ersaea lessonii* (Huxley), 1859. *Eudoxia lessonii*, Huxley (1859, p. 57, Pl. III.). *Ersaea compressa*, Haeckel (1888, p. 123, Pl. XXXIV.).

There are about a dozen specimens in the collection and all have the anterior and posterior nectophores isolated.

The shape of the anterior nectophore is like the figure given by Mayer. The teeth round the mouth of the nectosac have nearly a smooth edge, with just a few fine denticulations near the apex. The largest nectophore measured 13 mm. in length. A few of the specimens have the siphosome well expanded and the cormidia are clearly shown.

The largest posterior nectophore measured 17 mm. in length, 7 mm. in breadth and 5 mm. in thickness. The teeth of the nectosac are smooth.

A few specimens of the Eudoxia stage were found. One resembles Huxley's figure of *Eudoxia lessonii*.

Distribution. Atlantic Ocean; Tropical and subtropical regions. Australasian Seas; Amboina Is. (Bedot). Indian Ocean; Minikoi (Gardiner, 3rd Aug. 1899).

Genus *Abyla*, Quoy et Gaimard, 1827.

Abyla trigona, Quoy et Gaimard, 1827.

Abyla carina, Haeckel (1888, p. 156, Pl. XXXV.). *Abyla trigona*, Chun (1897, p. 31).

There is a single anterior nectophore resembling very closely Haeckel's figure (Haeckel, Pl. XXXV. fig. 5). It differs only in having a slightly flatter apex and the lateral wings project a little further out. The positions of the nectosac, the somatocyst, and the hydroecium correspond exactly to the position of these organs in Haeckel's figure of *Abyla carina*. The posterior nectophore was not found.

Distribution. Atlantic Ocean, Tropical and subtropical regions. Indian Ocean; Maldive Is. Miladumadulu (Gardiner).

Order Physophorae, Eschscholtz, 1829.

Family **Agalmidae.**

Genus *Agalmopsis*, Sars, 1846.

There is only one specimen. It is badly contracted and has lost all the nectophores and bracts. The tricornuate tentilla are large. I have not been able to identify the species. Bedot has found *Agalmopsis sarsi* off the Amboina Islands.

Family **Physalidae**, Brandt, 1835.

Physalia utriculus, Eschscholtz, 1829.

Physalia utriculus, Huxley (1859, p. 101, Pl. X., Pl. XII. fig. 12).

About two dozen specimens in the collection. The float of the smallest specimen is about 4 mm. in length and 2 mm. in depth. It has one tentacle and a few siphons and palpons. A specimen with a float measuring 8 mm. in length and 4 mm. in depth has a crest on the top of the float and a few internal transverse septa; one main tentacle and one secondary tentacle much smaller in size; several siphons and palpons; and the gonophores just beginning to develop. The largest specimens are about 20—25 mm. in length and 15—20 mm. in depth and have one main tentacle and several secondary tentacles. Numerous siphons and palpons. The gonophores are fairly well advanced in development. These large specimens resemble Huxley's figure of *Physalia utriculus*.

Distribution. Tropical and Pacific and Indian Oceans (Huxley). Maldive Is., Minikoi. Laccadive Is. (Gardiner).

Family **Velellidae**, Eschscholtz, 1829.

Genus *Velella*, Lamarck, 1819.

The collection contains a single small specimen about 13 mm. in length having a triangular sail about 7 mm. in height. The tentacles are arranged in a single row round the margin of the umbrella. The gonophores are beginning to develop on the gonostyles. The specimen from its size and the appearance of the gonophores is an intermediate stage. Until the Velellidae have been revised it is impossible to identify an intermediate stage.

University College, London, 22nd April, 1904.

A paper by H. B. Bigelow on "Medusae from the Maldive Islands," published in the *Bulletin of the Museum of Comparative Zoology at Harvard College* (Vol. xxxix. No. 9, April, 1904) arrived in London whilst I was revising the proofs of my paper. The author, along with Prof. A. Agassiz, visited the Maldive Islands during the months of December, 1901 and January, 1902. Special attention was given to the Medusae and the drawings of the species were made from life. The list of Hydromedusae contains 22 species, eleven of which are described and figured as new species. Not one of the species, which I have described as new, was taken during this expedition.

I have also just received from the *Concilium Bibliographicum* at Zurich the title of the following paper, "The Craspedote Medusa *Olindias* and some of its Natural Allies," 1903, in *The Mark Anniversary Volume*, pp. 1—22, 3 pls. I have been unable to find a copy of this book in the Scientific Libraries in London.

Whilst my manuscript was in the hands of the printer I examined about 40 specimens of *Solmundella bitentaculata* taken by Prof. Herdman at Ceylon. These specimens show that the shape of the umbrella is variable. One of them has the top of the umbrella very much like the original figure of the species given by Quoy and Gaimard. In the largest specimens there are three sense organs in each octant, but the smaller ones have only two sense organs in each octant. I consider the Maldive specimens to be an intermediate stage in development. Bigelow found *Aeginella dissonema*, Haeckel, at the Maldives, and as this species is widely distributed, it is probably identical with *Solmundella bitentaculata*. Maas (1904) has pointed out that *Aeginella* is the name of a Crustacean genus and that it cannot be used for a medusa.

24*th May*, 1904.

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DESCRIPTION OF THE PLATES.

Reference Letters.

CC. = Circular canal.	*St.* = Stomach.
G. = Gonads.	*S.* = Sense organ.
Or. = Oral lips.	*T.* = Tentacle.
N. = Nematocysts.	*U.* = Umbrella.
P. = Excretory pore.	*V.* = Velum.
R. = Radial canals.	*X.* = Ex-Umbrella.

All the figures were made from specimens in formalin.

PLATE LIV.

FIG. 1. *Proboscidactyla varians* sp. n. Oral view. × 25. (p. 728.)

FIG. 2. Lateral view of a tentacle of *Proboscidactyla varians*.

Fig. 3. *Liriope tetraphylla* (Chamisso et Eysenhardt). × 10. (p. 738.)

Fig. 4. *Phialidium tenue* sp. n. Oral view. × 5. (p. 730.)

Fig. 5. Lateral view of the peduncle, stomach and mouth of *Amphogona apsteini*. × 65. (p. 739.)

Fig. 6. *Diphyes chamissonis*, Huxley. × 5. (p. 743.)

PLATE LV.

Fig. 1. *Pseudoclytia gardineri* sp. n. Male. Oral view. × 40. (p. 731.)

Fig. 2. *Pseudoclytia gardineri* sp. n. Female. Oral view. × 40. (p. 731.)

Fig. 3. Optical section of the group of bulbs on the margin of the umbrella of *Pseudoclytia*. × 55.

Fig. 4. *Mesonema pensile* (Modeer). × $1\frac{1}{2}$. (p. 733.)

Fig. 5. *Amphogona apsteini* (Vanhöffen). Oral view. × 18. (p. 739.)

PLATE LVI.

Fig. 1. *Amphogona apsteini* (Vanhöffen). Lateral view. × 21. (p. 739.)

Fig. 2. *Olindias singularis* sp. n. Lateral view. × 5. (p. 737.)

Fig. 3. *Solmundella bitentaculata* (Quoy et Gaimard). × 15. (p. 741.)

Figs. 4—12. *Aequorea maldivensis* sp. n. (p. 732.)

Fig. 4. The bulbs on the margin of the umbrella. Outer view. × 8.

Fig. 5. A portion of the margin of the mouth showing the lips. × $3\frac{1}{2}$.

Fig. 6. A portion of the sub-umbrella and stomach, oral view, showing the oral lips, the lower wall of the stomach, the gonads (male), and the marginal organs. × 3.

Fig. 7. Radial canals and the gonads (female). × 3.

Fig. 8. The oral lips. Outer view. × 10.

Fig. 9. The oral lips. Inner view. × 10.

Fig. 10. A tentacle, showing the outer view of the basal bulb. × 10.

Fig. 11. A tentacle, showing the inner view of the basal bulb. × 10.

Fig. 12. A tentacle, showing the lateral view of the basal bulb. × 10.

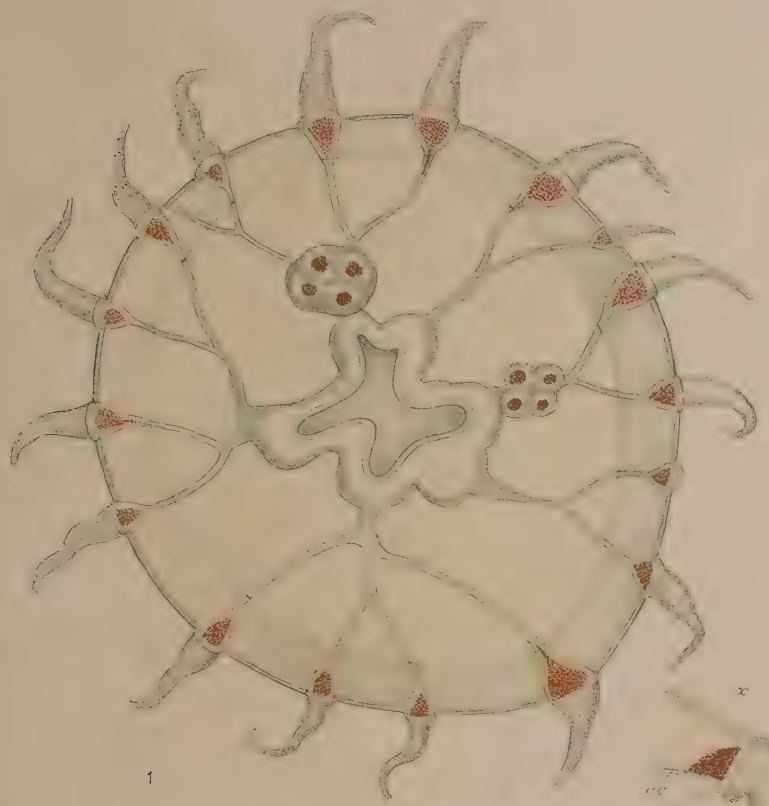
PLATE LVII.

Fig. 1. The tentacles of *Olindias singularis*, the marginal bulbs, and sense organs. Outer view.

Figs. 2—9. *Mesonema pensile* (Modeer). (p. 733.)

Fig. 2. Diagram showing a transverse section of the umbrella. Nat. size.

Fig. 3. A portion of the sub-umbrella and stomach, oral view, showing the oral lips, the lower rudimentary wall of the stomach, the gonads (male), and the marginal organs. × 3.



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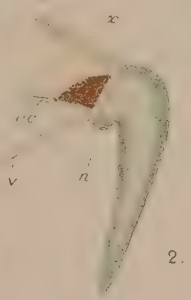

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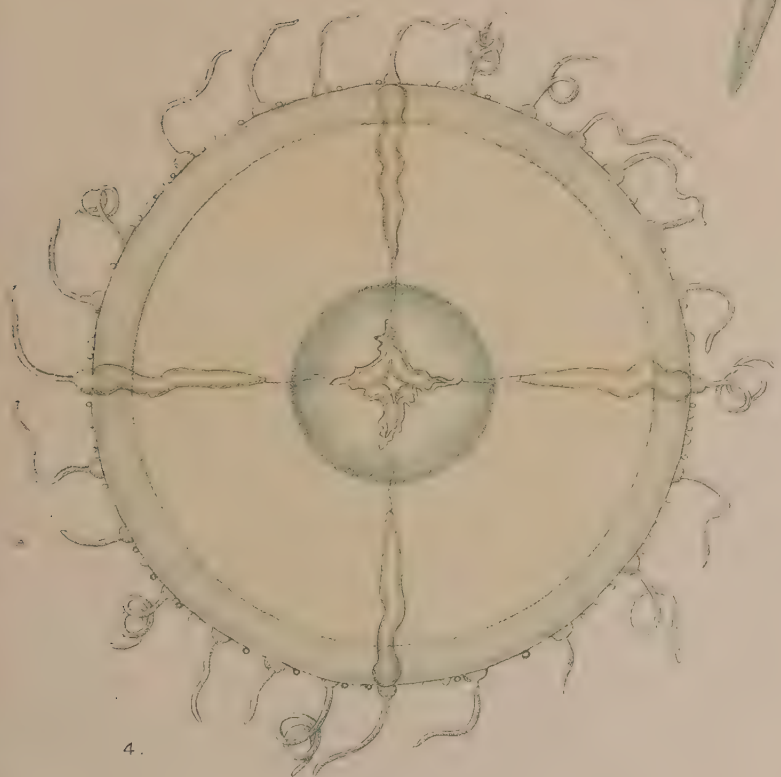

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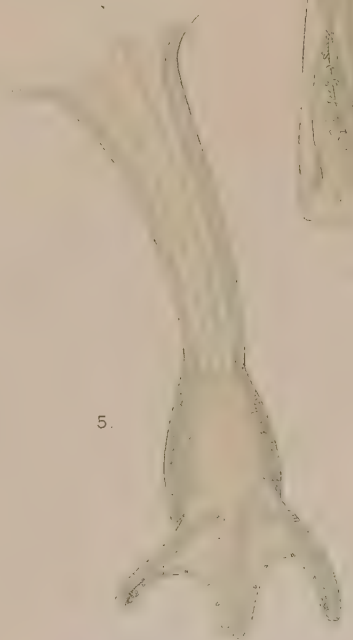

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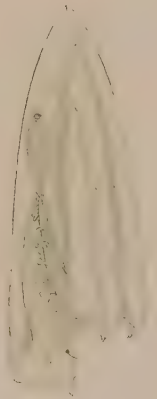

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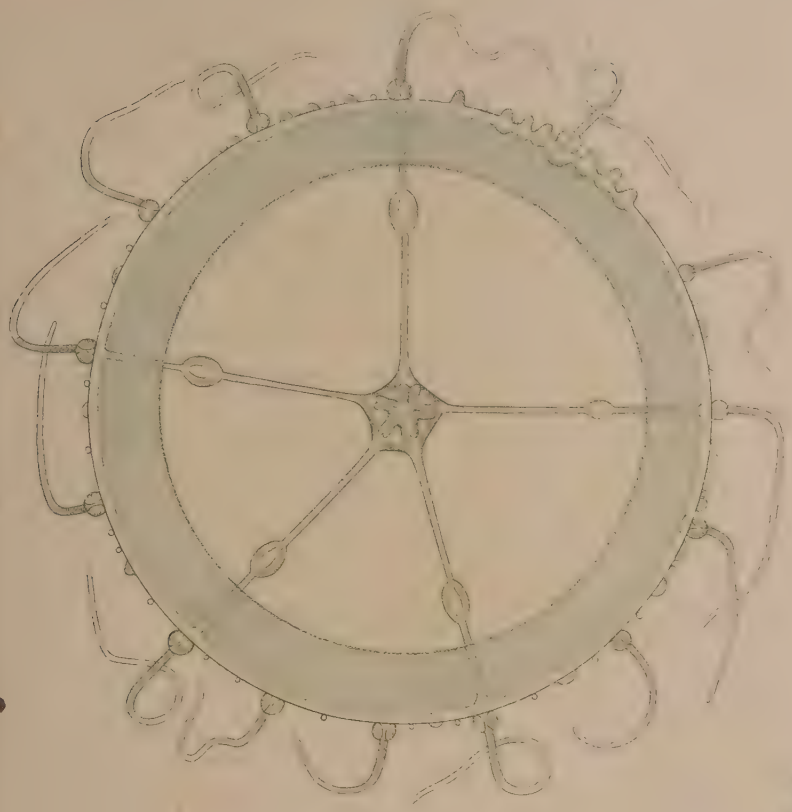

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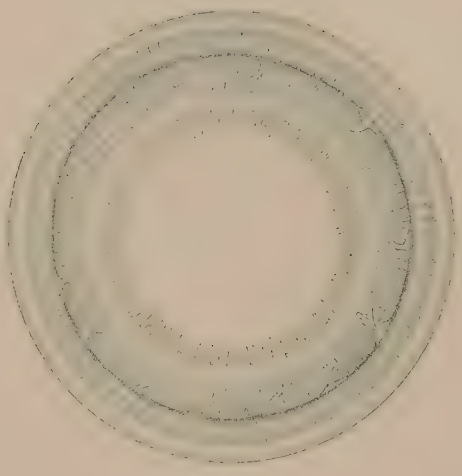

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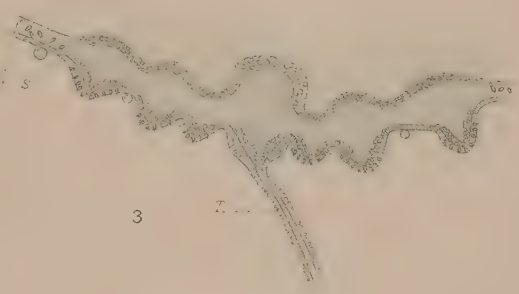

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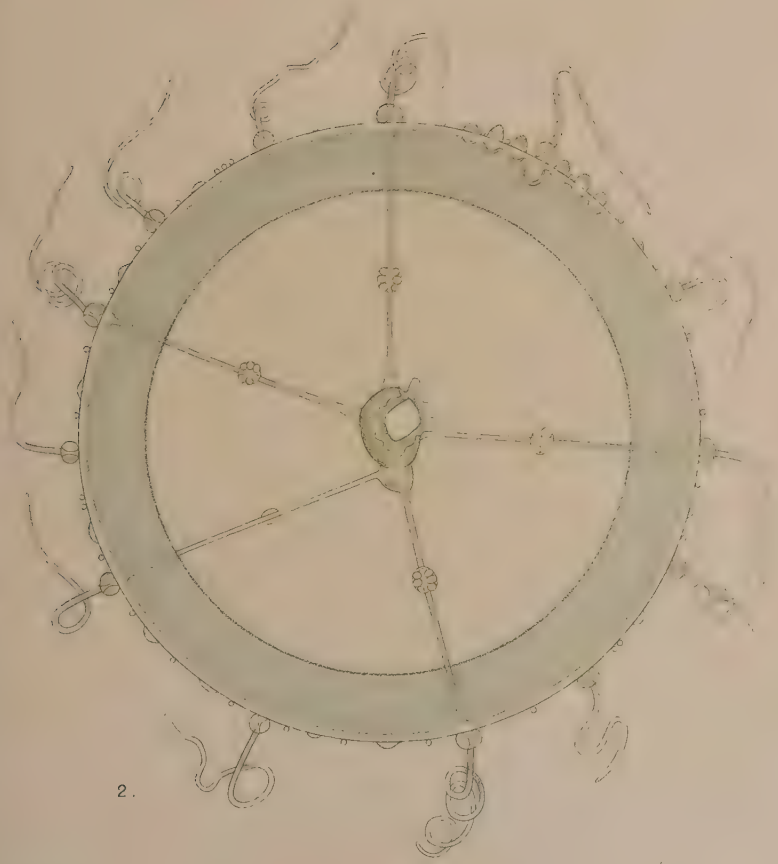

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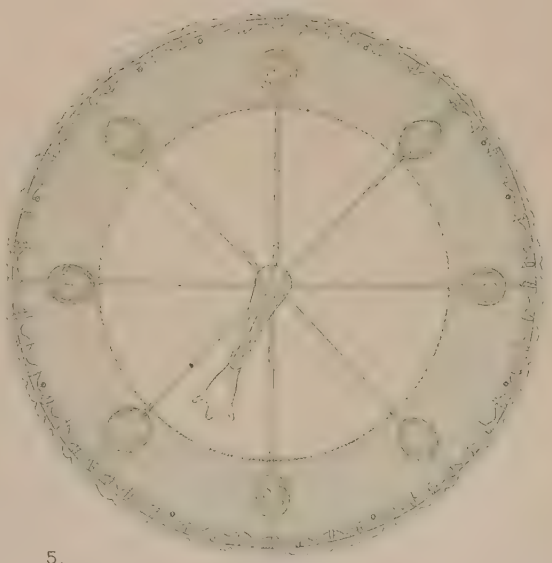

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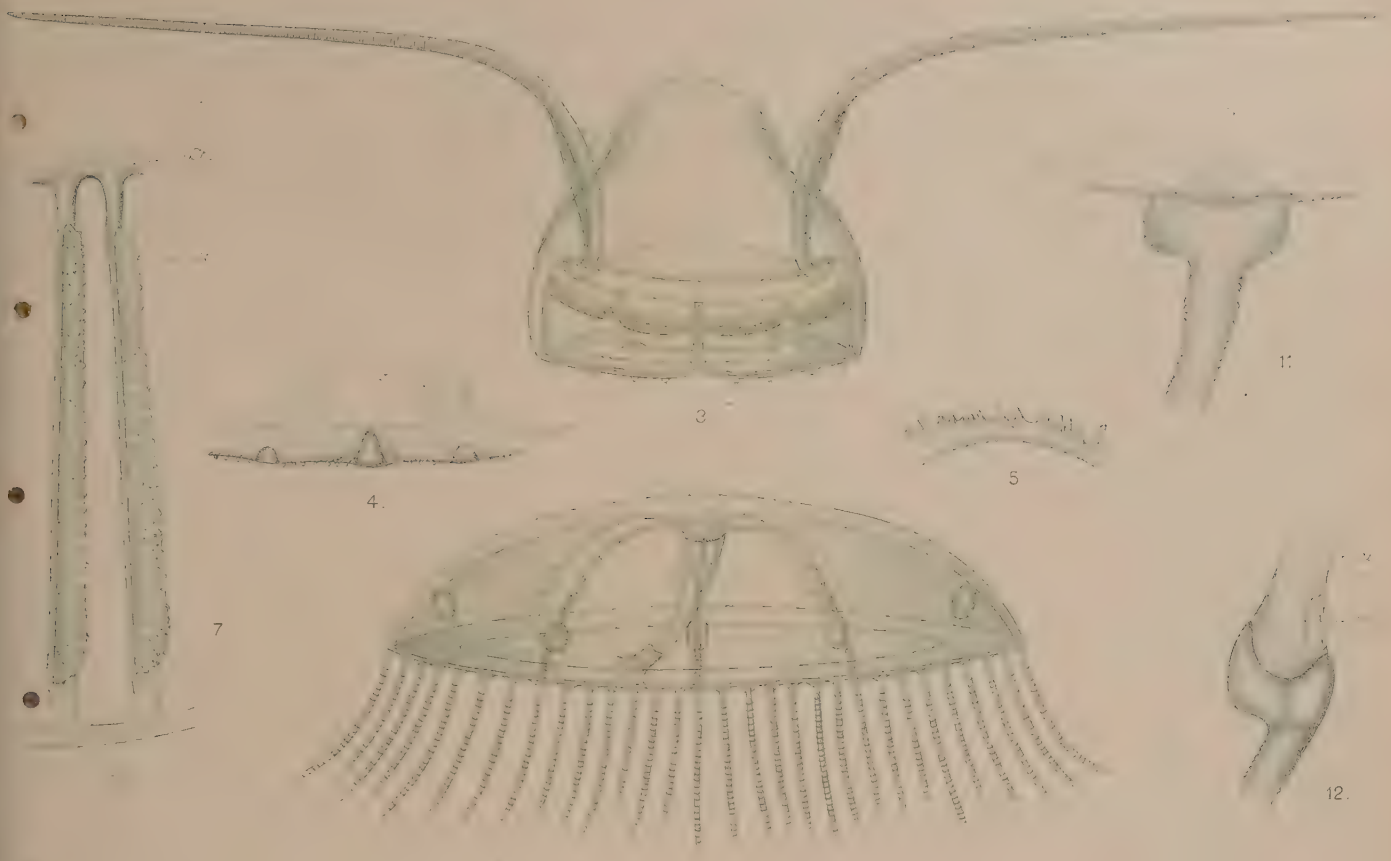

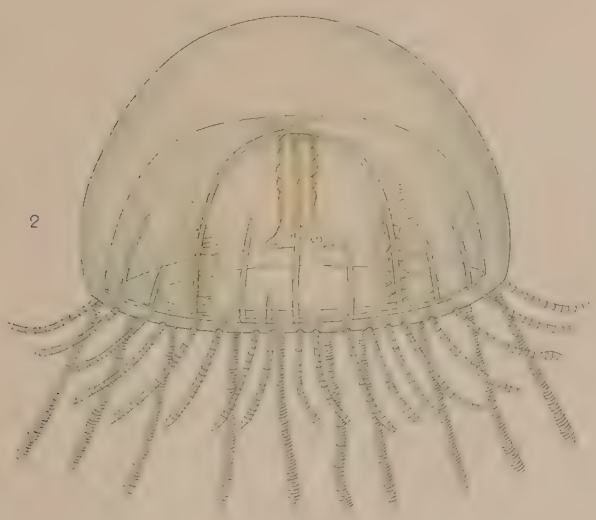

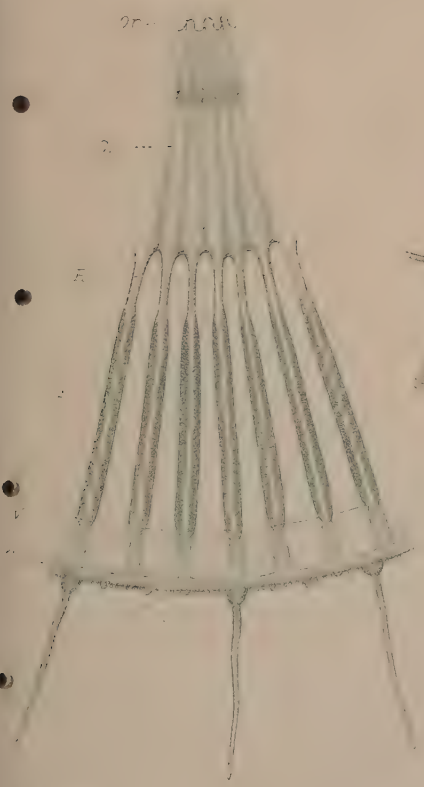

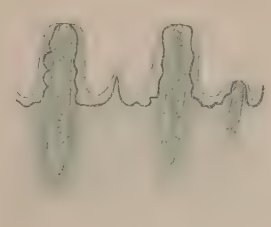

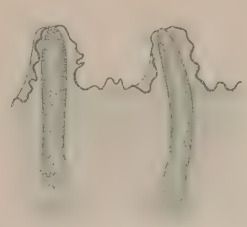

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BROWNE - MEDUSAE.

ÆNE - MEDUSÆ

FIG. 4. Radial canals and the gonads (female). × 5.

FIG. 5. The bulbs on the margin of the umbrella. Outer view. × 25.

FIG. 6. A tentacle showing the inner view of the basal bulb. × 10.

FIG. 7. A tentacle showing the outer view of the basal bulb. × 10.

FIG. 8. A tentacle showing the lateral view of the basal bulb. × 10.

FIG. 9. The oral lips. Outer view. × 10.

FIGS. 10—15. *Amphogona apsteini.* (p. 739.)

FIG. 10. A tentacle of *Amphogona apsteini.* Outer view.

FIG. 11. The external view of the spermary.

FIG. 12. A section of the spermary.

FIG. 13. The external view of the ovary.

FIG. 14. A section of the ovary.

FIG. 15. A sense organ, optical section. × 300.

FIG. 16. Basal bulb of a tentacle of *Phialidium tenue.* Outer view. × 65.

MARINE CRUSTACEANS.

XIII. THE HIPPIDEA, THALASSINIDEA AND SCYLLARIDEA.

By L. A. Borradaile, M.A., *Lecturer in Natural Sciences at Selwyn College, Cambridge.*

(With Plate LVIII.)

Fourteen species belonging to various groups of reptant decapods are enumerated in the following lists. Two of them are new. All the rest have already been recorded from the Indopacific region, with the exception of a species of *Callianassa* which I am unable to distinguish from a Martinique form.

Suborder Anomura. Tribe Hippidea.

The members of this group are all shallow water forms which live buried in the sand. They are particularly plentiful at the very edge of the water on beaches of loose sand, retreating with the outgoing tide and burrowing with extraordinary rapidity by means of their flat legs with sickle-shaped ends. Garstang has described[1] the way in which the antennules of *Albunea* are adapted to this habitat, forming a filter to keep the sand out of the breathing stream. In the case of most species of *Remipes* a sort of chamber is formed by the long hairs on the short antennae and inner flagella of the antennules[2]. The animal lies in the sand with the eyes just showing and this chamber at the surface to filter the water. It may easily be caught by a bait of crab at the end of a line, pouncing on it with its sharp maxillipeds and allowing itself to be flicked out of the sand if the rod be sharply lifted.

Quite a number of the peculiarities of other sand Decapoda are repeated independently in the Hippidea. The so-called subchelate hands of *Albunea* are found, as we have seen (p. 683), in various Oxystomes and Parthenopidae and in *Kraussia*, and the flattened legs of all Hippidea in *Ranina*, *Matuta* and *Kraussia*. The overlapping carapace of *Remipes* is also common among Oxystomes and Parthenopidae. The outward channel from the gill-chamber is carried, in Hippidea as in Oxystomata, by the endopodite of the first maxilliped. The antennules of *Albunea* are analogous to the antennae of the Corystidae. And the smooth surface

[1] *Q.J.M.S.* xl. p. 224. I regret the accidental omission of a reference to this paper from the article on the Oxystomata, in the course of which some interesting suggestions of Mr Garstang were confirmed.

[2] This is not conspicuous in the species figured below.

of the back of most Hippidea, marked with fine transverse ridges, is repeated in *Kraussia* and, more coarsely, in some species of *Calappa*. It is such striking and quite independently evolved likenesses as these which lend strength to the view that the resemblances between Hippidea and Oxystomes are due to convergence only, and not genetic.

Family **Albuneidae**[1]. Genus *Albunea* Fabr., 1798.

1. *Albunea microps* Miers, 1879. *J. Linn. Soc.* XII. p. 328.

Dredged in Mahlosmadulu Atoll in 20 fathoms of water.

2. ? *Albunea speciosa* Dana, 1852. *U.S. Expl. Expd. Crust.* I. p. 405.

The telson in my specimen is more oval than in Dana's figure, and is pointed. This, however, may be only a sexual difference (Dana does not state the sex of his specimens; mine is a male) or the species may be variable or varietal in this respect. Dana refers to and figures the eye-scales as one triangular plate between the eyes.

The *Blepharipoda fauriana* of Bouvier (*Ann. Soc. Ent. France*, 1898) seems to be allied to this species. Probably the genera *Albunea* and *Blepharipoda* meet near here.

Taken at Hulule, Male Atoll.

Family **Hippidae.** Genus *Remipes* Latr., 1806.

3. *Remipes testudinarius* Latr., 1806. De Man, *Zool. Jahrb.* VI. *Syst.* p. 476.

Taken at Hulule, Male Atoll, between tide-marks.

4. *Remipes pacificus* Dana, 1852. De Man, *loc. cit.*

Taken between tide-marks in Male and Minikoi Atolls, and dredged in Hulule Velu and Mahlosmadulu Atoll in 7 and 6 fathoms respectively.

5. *Remipes granulatus* n. sp. (Pl. LVIII. fig. 1.)

Definition: "A *Remipes* with the carapace finely granular all over and raised into little irregular lumps; the front notched but without a middle tooth in the notch; the outer teeth of the fore edge not quite so long as those of the front and passing evenly into the side edge of the carapace without an angle; the post-frontal groove fairly distinct, behind this a low irregular hollow on each side of the middle line, about a third of the length of the carapace from its fore edge, and behind these again two half-moon shaped cracks in the same position; about 35 pits along each side of the carapace; the eyestalks short; the 'flagellum' of the 2nd antenna of one joint only; the end-joint of the first leg as long as the propodite, slightly compressed, smooth on the inside, tufted with hairs here and there on the outside, fringed above, below, and at the end; and the last joint in the 2nd and 3rd legs short, broad, bent at an obtuse angle."

[1] *Key to the families of the Hippidea.*

I. First pair of legs subchelate. Carapace flattened, without wings to cover the legs. 3rd maxilliped narrow, with exopodite. *Albuneidae.*

II. First pair of legs simple. Carapace subcylindrical, with wings which cover the legs. 3rd maxilliped broad, without exopodite. *Hippidae.*

Length of single specimen: 9 mm. Colour in spirit: dead white. Differs from all other species in the granular surface of the back.

One female, taken between tide-marks at Hulule, Male Atoll.

Tribe Thalassinidea.

With the exception of a few Axiidae[1] which hide in weed, and such species as *Callianassa lignicola*, taken from the hollow of a submerged twig, all the members of this tribe are either burrowers, making galleries, which are often long and deep, in sandy or muddy bottoms, or at least live in burrows made by other animals. Those which burrow between tide-marks usually retire to the bottom of their holes when the tide is out, but they can sometimes be seen just within the opening, when it is almost covered by the water. At such times some at least of them may often be made to seize a bait but are very wary and hard to catch. In spite of certain primitive characters which really remove them from the Nephropsidea, they are at first sight very lobster-like in habit of body, but the abdomen, which is usually softened, the compressed carapace and last pair or more of legs carried close against the sides, and the reduced eyes are easily seen to be consequences of their peculiar mode of life.

Family **Axiidae.** Genus *Axiopsis* Borradaile, 1903.

For a definition of this genus see *Ann. Mag. Nat. Hist.* (7) xii. p. 538.

1. *Axiopsis affinis* (de Man), 1887. *Arch. Naturges.* liii. i. p. 469.

A specimen was taken between tide-marks at Hulule, Male Atoll. It was of a purple colour and lived in a purple weed.

Family **Callianassidae.** Subfamily **Gebiinae.**

Genus *Upogebia* Leach, 1814.

2. *Upogebia* sp.

A damaged specimen of a *Upogebia* allied to *U. major* (de Haan), but differing from it in having no row of small teeth on the outside of the hand, was dredged in Mulaku Atoll in 30 fathoms of water.

Subfamily **Callianassinae.** Genus *Callianidea* H. M.-Edw., 1837.

3. *Callianidea typa* H. M.-Edw., 1837. *H. Nat. Crust.* ii. p. 320.

Taken between tide-marks at Goidu, Goifurfehendu Atoll.

Genus *Callianassa* Leach, 1814.

4. ?*Callianassa* (*Callichirus*) *longiventris* A. M.-Edw., 1870. (Pl. LVIII. fig. 2.) *Nouv. Arch. Mus.* vi. p. 92.

[1] For a key to the families, etc. of the Thalassinidea see *Ann. Mag. Nat. Hist.* (7) xii. p. 549.

This species is recorded by Milne-Edwards from Martinique, but I am unable to find any difference between our Maldive specimen and his description. Milne-Edwards gives no figure, but a comparison will be made more easy by that in the accompanying plate.

Taken between tide-marks at Goidu, Goifurfehendu Atoll.

5. *Callianassa* (*Callichirus*) *novae-britanniae* Borradaile, 1900. Willey's *Zool. Results* IV. p. 419.

The specimen is small and the carapace very soft, so that the lines on it are not easily seen. Fig. 125, on p. 691 above, is from the New Britain specimen, and shows well the two longitudinal lines—*linea thalassinica* and *linea anomurica*—which, by a very rare exception, are here found together.

Taken between tide-marks at Goidu, Goifurfehendu Atoll.

6. *Callianassa* (*Trypaea*) *maldivensis* n. sp. (Pl. LVIII, fig. 3.)

Definition: "A *Callianassa* with the eyestalks short, flattened, pointed, with the cornea on the outside; the rostrum sharp, reaching to the end of the cornea; no antennal tooth on the carapace; the segments of the abdomen about equal, but the first rather shorter, and the second rather longer than the rest; the third joint of the antennular stalk longer than the others, as long as the flagella; the third maxillipeds with the ischiopodite and meropodite broad, but the last three joints narrow; the palm of the great chela as broad as, and about twice as long as, the wrist, both wrist and palm sharp-edged above and below, scantily hairy except on the fingers, the lower edge of the palm saw-like within at the base, that of the ischiopodite and meropodite with strong curved teeth; the telson as long as the sixth abdominal limb."

Length of the single specimen: 19 mm. Colour in spirit: white.

Taken between tide-marks at Hulule, Male Atoll.

Suborder Macrura. Tribe Scyllaridea.

The members of this group are for the most part large and have heavy, well-armoured bodies which are generally somewhat flattened, at least in the abdomen, and almost, or quite, unprovided with a rostrum. They are distinguished from nearly all other Decapoda by having none of their legs chelate, except sometimes the last pair, but they are not on this account defenceless, for the abdominal segments usually carry at each side a sharp point, and the abdomen thus becomes a powerful weapon which can be used with great effect. They mostly live in water which is at least several fathoms deep, but the rock-lobsters may be taken between tide-marks at night in the tropics, and small specimens are found in the same place in daylight. Of the two families[1], the Scyllaridae or bear crabs are found on sandy bottoms, where they probably use as shovels the broad, flat plates which represent their antennae, but the Palinuridae, or rock-lobsters, like rocky ground, often living on the outer slopes of coral reefs, but never in the lagoons. The antennae of this family have very long, stout, stiff flagella, and generally a special roughened surface on the first free

[1] *Key to the families of the Scyllaridea.*

I. Carapace cylindrical. Eyes in incomplete orbits. Antennae with long, stiff flagella. *Palinuridae.*

II. Carapace flat. Eyes in complete orbits. Flagellum of antenna represented by a flat plate. *Scyllaridae.*

joint, with which they can make a sound by rubbing it against the head. It would be interesting to know the use of this noise.

Family **Palinuridae.** Genus *Panulirus* White, 1847.

1. *Panulirus penicillatus* (Oliv.), 1791. Ortmann, *Zool. Jahrb.* VI. *Syst.* p. 28.

Dried shells found on the outer beach at Minikoi. These dried shells of rock-lobsters are strangely more common on the beach than those of other Decapoda. Whether this be due, as the natives say, to the creatures coming up to the surface to shed them, or to their getting killed on the reef in some way, is hard to say, but I have never seen one with the soft parts inside.

2. *Panulirus polyphagus* (Hbst.), 1793. Ortmann, *Zool. Jahrb.* X. *Syst.* p. 266.

My specimens have no white band across the abdominal segments, and the white markings on the legs are in stripes running lengthwise, but broken and somewhat wandering. This form would seem to be the one to which Fabricius gave the name of *ornatus* (*Ent. Syst. Suppl.*, p. 400, 1798).

One dried shell from the beach and one very small individual taken alive on the reef at Minikoi. Common in the Maldives.

Family **Scyllaridae.** Genus *Scyllarus* Fabr., 1793.

3. *Scyllarus martensi* (Pfeffer), 1881. (Pl. LVIII. fig. 4.) Ortmann, *Zool. Jahrb.* VI. *Syst.* p. 44.

The four or five teeth on the inner edge of the second joint of the antenna in this species are each more or less deeply cleft into two in most of my specimens, so as to give a saw-like edge with twice the number of teeth.

Dredged in Mulaku, Kolumadulu, Mahlosmadulu, and South Nilandu, in depths of 20—40 fathoms, always on a bottom of sand or mud.

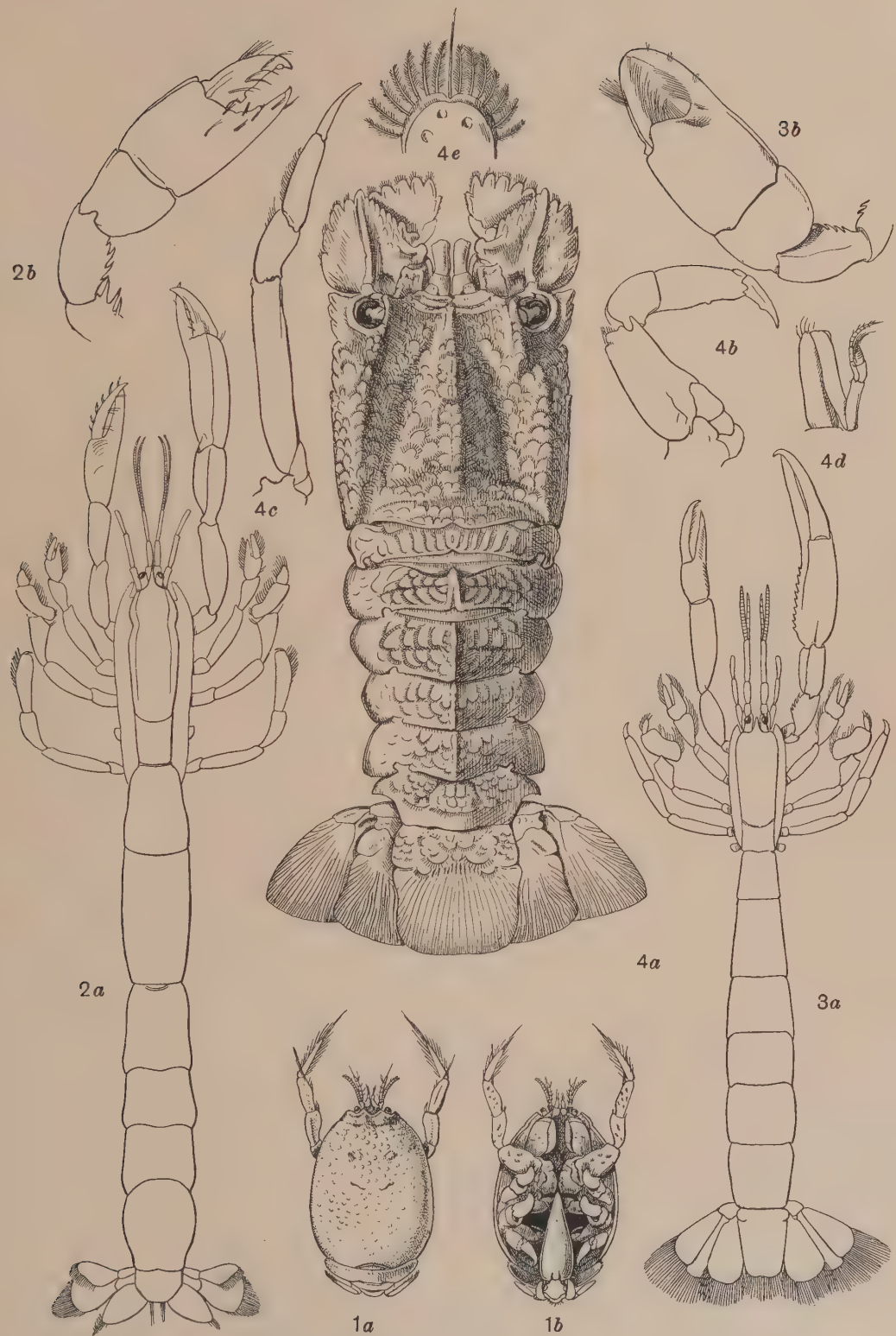
EXPLANATION OF PLATE LVIII.

FIG. 1. *Remipes granulatus* n. sp. *a.* from above, *b.* from beneath.

FIG. 2. ?*Callianassa longiventris* A. M.-Edw. *a.* whole animal from above, *b.* outside of greater hand. The lash of the antenna and the fourth leg on each side are lost.

FIG. 3. *Callianassa maldivensis* n. sp. *a.* whole animal from above, *b.* outside of greater hand. The lash of the antenna and the last leg on each side are lost.

FIG. 4. *Scyllarus martensi* Pfeffer, var. *a.* whole animal from above, *b.* first leg, *c.* third leg, *d.* antennule, folded up, *e.* one of the scales on the back greatly enlarged.



E. W. del.

BORRADAILE——MACRURA AND ANOMURA.

MADREPORARIA.

PARTS I. AND II.

By J. Stanley Gardiner, M.A., *Fellow of Gonville and Caius College, and Demonstrator in Animal Morphology in the University of Cambridge.*

(With Plates LIX.—LXIV.)

I. INTRODUCTION WITH NOTES ON VARIATION.

The present collection contains over 1,000 specimens of dried corals besides a large number in spirit and formalin and a quantity of smaller pieces for comparative purposes. The reef forms are mainly from the following localities: (*a*) Minikoi, the most southern bank of the Laccadive Group; (*b*) Goidu, the east island of Goifurfehendu atoll; and (*c*) Hulule, the most south-easternly island of N. Male atoll. An attempt was made to collect as thoroughly as possible—particularly at Minikoi and Hulule—for the comparison of the localities with one another, and specimens were not generally taken from reefs elsewhere. In addition, dredgings yielded a considerable number of specimens, although few hauls were taken on the outer slopes of the reefs.

The colours of the living colonies were noted at Minikoi, and both at Minikoi and Hulule careful records were kept of the situations where the various species grew. In many cases rough notes were added so as to show the actual positions in which the living corals stood, both for comparison with the upheaved reefs of the locality and so far as possible to ascertain how far mode of growth is dependent on light and environmental conditions. These observations were of immediate value in my study of the coral reef question, and have been of great assistance in working out the collection. I had intended to have given an account of the variability due to these causes, but the limited interest of the subject and the cost of suitable illustrations have reluctantly compelled me to forgo the task. I have under each species indicated as briefly as possible the variation that is found in the several colonies due to these causes.

I divide the *variation* shown by corals into three classes: (*a*) that referred to above, *i.e. vegetative*; (*b*) *continuous*; and (*c*) *discontinuous* or *specific*. Of the latter the only instances definitely known in corals, so far as I am aware, are those of Flabellum rubrum and stokesi and of the two forms of Heterocyathus[1]. Below I have suggested certain additional variations as belonging to this class, such as that shown by the two varieties of Acanthastraea hirsuta, lobed and massive forms of Hydnophora microcona, and three similar species of

[1] *Vide Marine Investigations in S. Africa*, 1902, p. 211 *et seq.* and 1904 in the Press; also *Proc. Camb. Phil. Soc.*, vol. xi. p. 463, 1902.

Echinopora. I am aware that they are very doubtful, at least 500 or 1000 specimens being required to establish any case, but I am of opinion that the phenomenon is much commoner in corals than has been previously supposed.

A species in one locality may show definite *discontinuous* variations in one or more characters, but it by no means follows that the same discontinuous variations will be shown by the same species in a different locality. The specimens may, indeed, show none of the same discontinuous variations, though others may be clearly indicated. It is not improbable that a large collection of one and the same species from many localities would appear to vary in a perfectly continuous manner, and thus all idea of its true variability would be lost. Work on a collection from a single locality is best calculated to bring out the phenomenon, but one requires a collection from some other locality for comparison. This I have to some extent had in my Rotuma and Funafuti collections, but unfortunately they are not nearly large enough for the purpose.

Mr Bernard's method of cataloguing the corals of the British Museum (Vol. IV.) appears to me to be well calculated to throw light on discontinuous variability, but we require a still further development of his system of tables, comparisons of two, three, or as many characters as possible, those particularly that are capable of being expressed in numerical terms[1]. Mr Bernard was in my opinion unfortunate in starting on Goniopora, though he has got results of great value, because there are relatively few specimens of the genus in the Museum. The fact that Mr Bernard is able to place the specimens of each single locality under so many forms, whereas the species are in his present collections impossible to determine, points to the probability of discontinuous variability being, as I have above inferred, from my own collections. Later on, no doubt the species will be determinable with their various discontinuous variations. It will then be possible to see how far the environment and the physical conditions of the localities have affected the parent corallites to cause them to vary their gametes. For this purpose sedentary organisms and particularly corals are peculiarly favourable, because they can, so far as we are aware, in no way make choice of their environment, and must all be affected in any region by the same physical conditions. Larvae of neighbouring localities, such as Ceylon and the Maldives, would certainly be interchanged to some extent, but the immensely greater number of coral colonies in a locality would presumably be produced from larvae of the same locality. Yet, unless there is a real action of the environment in each region in producing its peculiar discontinuous variations in the gametes of the new immigrants it will be obvious that the species must remain approximately constant.

The second class of variation referred to is the *continuous*. That it exists in a very definite form is shown in some species below, but it is exceedingly complex and almost impossible to satisfactorily distinguish from the vegetative. The physical conditions of the Red Sea, Maldives, and Rotuma differ very markedly, and if their action is of any great importance in natural selection, we should not unnaturally expect to find considerable differences between the corals of the three regions. Yet the opposite is the case—more especially between the Red Sea and the Maldives, which are the most different—very many species being precisely the same, *i.e.* showing no dissimilarities in their specific characters. Yet, there does appear to be a real difference. The Red Sea specimens of Astraeidae, considered in their entirety, have larger corallites and calices, and are smoother with less exsert and less toothed septa than the Maldivan, which in the same characters lie intermediate to those

[1] Anyone working at the question could to a large extent do this for himself from Mr Bernard's last catalogue.

from Rotuma and Funafuti, in each species however the specific characters being clearly recognisable. Indeed, there would appear to be a locality mode for certain characters in each genus, a fact which Mr Bernard's catalogue of Goniopora certainly illustrates. The characters, which thus vary, may be all to some extent vegetative, but can they be entirely so? They do not, so far as my study has gone, seem to include the characters on which the species in any genus are founded, whereas discontinuous variation chiefly affects these characters. The differences in the specimens between the different localities referred to are small, but, if they be due to natural selection, the logical result of its action would be to produce ultimately fresh genera with parallel species. There is no sign of any such action going on at the present time. Coral genera are extremely widely spread, and the same species are found in widely separated regions. If, as seems probable, such species are not found in intermediate regions, this fact would point to their presence in these distant regions as due either to the fixation of such a number of discontinuous variations as form their specific characters, in a word to the parallel formation of discontinuous variations, or on the other hand, to the particular species having once extended over the whole area and been killed out or altered in the intermediate areas. The difficulties in respect to the last view are obvious, when one considers the W. and E. Indies, or the Red Sea or Maldives and the Philippines, but it is useless discussing the matter further until we have definite accounts of considerable collections of several genera from different localities.

With regard to the *species question in corals* I can only say that I have not found the same difficulty with the Astraeidae that Mr Bernard has *certainly* experienced in the perforate genera. The species seem definitely separated and constituted, and I feel reasonably certain that I am dealing with definite species or varieties. Before attempting to name, I sorted each genus into its species, a task in which I was much assisted by my notes above referred to, placing under each specimen a paper with measurements and notes of all such characters as seemed to me to be specific in its genus. I then proceeded in the usual way, but I have been much aided by criticism from Prof. Jeffrey Bell and Mr Bernard, and the kindness of these gentlemen in assisting me on many occasions in examining the British Museum collections. The difficulties of the work can only be appreciated by those who have examined sedentary organisms. Many of the so-called species are described on extreme vegetative varieties, or on single small specimens from unknown localities, very commonly without figures, while in many descriptions all reference to half or more of the specific characters is omitted. Considering the dates of their publication, I can only pay a high tribute to Milne-Edwards and Haime's great work, *Histoire des Coralliaires*, and Klunzinger's *Die Korallthiere des Rothen Meeres*, in referring to each of which I have merely mentioned the page and figures under their authors' names. I have also adopted the same course in reference to Dana's *Zoophytes* and my paper on my Pacific Ocean Astraeidae (*Proc. Zool. Soc.*, 1899, p. 734). References to other literature will be found in the above works; I have in the majority of cases not given other references unless they throw some definite light, that the above do not, on the species under consideration. I am particularly indebted to Klunzinger's interpretation and photo-figures of Ehrenberg's specimens. It is to be hoped that the same may be done for Duchaissaing and Michelotti, and also that Prof. Verrill will figure the species that he has described. However, I am not much affected by the work of these authors, since the American species, on which they principally worked, are taken altogether widely different from the Maldivan.

II. ASTRAEIDAE.

The specimens of this family number about 400; many are small fragments, or from the same colony, or young colonies, so that only about half are enumerated as being of use for comparative purposes. They are divided into 69 species of 21 genera. The number of the latter is remarkable as compared with the 12 genera obtained by me in the Pacific and the 16 genera (omitting synonyms) described by Klunzinger from the Red Sea. Definite comparisons and general observations on the family I defer until the whole collection has been worked out.

I have with certain exceptions arranged the genera according to Duncan's classification (*Linn. Soc. Journ.*, vol. XVIII. pp. 1—204), which is in need of thorough revision. Where no references to the genera are given, they are implied to this work. As defined by Duncan I use the term *corallite* as an individual member of a colony, *calice* as the upper opening of the corallite within the theca (or epitheca if it extends to the opening), and *columella* as the structure which fills up the axis of the corallite or calice. When a definite structure is laid down covering the outermost sides of a colony or a simple coral, it is termed *epitheca*; it has everywhere a morphological character in that it is deposited from one side only, *i.e.* the inner, no part of the living tissues extending outside it. The *wall* is the structure which separates a calice from the exterior, or two calices from each other. The *depth of the calice* is the vertical distance between the top of the theca and that of the columella. *Dissepiments* are of two kinds, exothecal and endothecal, outside and within the theca.

I. Genus *Antillia*.

1. Antillia constricta Brüg., var. maldivensis nov. (Pl. LIX. figs. 4 and 5.)

Brüggemann, *Ann. Mag. Nat. Hist.*, ser. 4, vol. XX. p. 309 (1877).

The species has a columella formed of trabeculae flattened parallel to the long axis of the corallum, while var. maldivensis has a spongy columella with a rather papillose surface.

My three specimens measure (1) 75 mm. long, 43 mm. broad, narrowest 19 mm., and 57 mm. high, (2) 74 × 48, narrowest 18, and 52 mm. high, the corallum rather bent at the base, and (3) 69 × 42, narrowest 18, and 37 mm. high. The epitheca varies from 6 to 25 mm. from the edge of the cup. The smallest specimen closely agrees with the type in its shape and septal arrangements. In neither of the others is there any marked elevation of the walls on either side of the central constriction, and (2) is rather irregular at one end as if a second constriction was commencing to form. Septal cycles I—IV join the columella, and in the larger specimens the paliform lobes of III often approach in size and appearance those of the first two cycles. The specimens are 20, 20, and 15 mm. deep from top of theca to top of columella; the septa are 2·5—3 mm. exsert.

Locality. Suvadiva, 31 *f.*

II. Genus *Cylicia*.

2. Cylicia ?stellata Dana. Dana, p. 377, XXVIII. 5.

I have not seen sufficient specimens of the genus—the British Museum has Ed. and H.'s type of C. excavata = C. tenella, but it has never been properly cleaned, and I can

find few other species—to venture on any determination of the species. The corallites of my specimens are extremely variable, but most show the *star* of the above species formed by the six primaries. The genus appears to me to be a very doubtful member of the Astraeidae, and would probably repay morphological investigation (both corallum and polyps).

Locality. Common under overhanging coral or rock masses of the boulder zone, reef-flat and lagoon reefs throughout the Maldives (not Minikoi). The corallites are only found in comparative darkness, and appear to shun the light. *Polyps* colourless.

III. Genus *Tridacophyllia.*

3. Tridacophyllia lactuca (Pallas). Dana, p. 195, IX. 10.

A single specimen from S. Nilandu, 30 *f.*, and a smaller piece, Felidu, 20 *f.*, seem to belong to this species as understood by Dana. The surface of the first is so distorted by worms and capsules of Pyrgoma, standing up for 1—2 cm., that identification is extremely difficult.

IV. Genus *Euphyllia.*

4. Euphyllia glabrescens (Chamisso). Ed. and H., II. p. 192 and Gard., p. 735.

The specimens differ from the Rotuma ones in that the septa very seldom rise above the wall. Fission takes place by a pinching in and fusion of the two opposite walls of an elongated corallite. The calices are often much distorted by the round tubular dwellings of Pyrgoma.

Locality. The colonies of this species may generally be found in hollows towards the inner side of the reef-flat or in protected situations, where there is no sand or mud, both at Minikoi and throughout the Maldive group. Where it occurs, as to the S. of Hulule, it is exceedingly abundant, but is nowhere a reef-builder. **Colour,** dull green.

5. Euphyllia turgida (Dana). Dana, p. 167, and Ed. and H., II. p. 193 (and *Ann. des Sc. Nat.*, t. x. pl. 6, fig. 1, 1848).

Three branched specimens with calices varying up to 4 cm. long by 2 cm. broad, closely agree with Ed. and H.'s description and figure, especially the section. The septa are scarcely exsert, and the corallites have a tendency to be constricted round their open ends.

Locality. North Male, 28 *f.*, and S. Nilandu, 36 *f.*

V. ? Genus *Mycetophyllia,* Ed. and H.

6. A small specimen with five calicular centres may belong to this genus. It presents a striking resemblance to Ed. and H.'s figure of M. lamarckana (*Ann. des Sc. Nat.*, t. x. pl. 8, fig. 6*a*), and does not agree with the young specimens of Mussa that I have seen.

Locality. Suvadiva, 40 *f.*, bottom covered with coarse rubble.

VI. Genus *Mussa*.

7. Mussa corymbosa (Forsk.).

Mussa corymbosa and cactus, Dana, pp. 177—8, VII. 1. M. corymbosa, Ed. and H., p. 333, and Klz., p. 6, I. 4 and 9. M. cactus, Gard., p. 737.

Locality. Sparingly on lagoon reefs and in holes of the reef-flat in the Maldives (six specimens). **Colour,** a brown padded edge, surrounding a green peristomial valley.

VII. Genus *Symphyllia*.

8. Symphyllia sinuosa (Q. and G.). (Pl. LIX. figs. 1, 2 and 3.)

Meandrina sinuosa, Quoy and Gaimard, *Voy. de l'Astr., Zooph.*, p. 227, Pl. XVIII. figs. 4 and 5 (1833); Symphyllia sinuosa, Ed. and H., II. p. 370, and Gard., p. 738.

I refer seven specimens to this species, and I have two further specimens from Rotuma and the Singapore region before me. They show clearly that the genus is formed by the fusion together of series such as are found in Mussa. The species is simply a massive Mussa closely related to M. corymbosa.

Internal structure. The dividing wall of the series in all the specimens possesses a distinct furrow or groove. In parts of some of the colonies it is a valley in the upper edge of the wall, but over the greater part of their surfaces is merely a narrow deep notch between the outer edges of the septal plates (septa + costae), which are only secondarily continuous between the calicular rows. This can be clearly seen from the surface owing to the fact that the septa of neighbouring rows are seldom exactly opposite to one another, and that the thicker septa rather tend to alternate than lie opposite. In section it is clear that the septa are not continuous, and in places one can distinguish between their outer edges a thin, vertically rising plate. The latter is much fenestrated, and is incomplete; it may be a secondary formation, but appears to be continuous right down to the epitheca of the colony, and in my view represents the remains of the fused epitheca of neighbouring rows. The exothecal dissepiments are 1·5—3 mm. apart in accordance with the thickness of the wall; they are not continuous between the theca of neighbouring rows, but are arched, convex side uppermost, from the theca to the centre of the wall, *i.e.* to the fused epithecal line above mentioned. The morphology appears to be the same in all the specimens, but there is great variation in the thickness of the walls (2·5—8 mm.), and in the thinner their structure may be almost obliterated so that they appear relatively solid. The endothecal dissepiments are lightly arched from the theca to the columella; they are thin and often form large vesicles about 2 mm. broad by 5—10 mm. long. The septa may be almost complete or much fenestrated, near their edges passing into flattened, upstanding plates, the innermost and smallest of which form the columella.

Variation. The specimens in their internal structure show little variation except what is dependent on the thickness of the walls and the distinctness of the furrows, both already referred to. There are two classes of septa, (*a*) coarse, upstanding, 3—5 mm. exsert, 1—2 mm. thick over the theca, with 1—3 great pointed teeth near their upper edges, passing internally into blunter lobes or relatively fine teeth, and (*b*) fine, not more than 2 mm. exsert nor 1 mm. thick, closely set internally with fine pointed teeth. In the Rotuma specimen there

is less difference in the two classes than in any of the present collection, though all the characters of the latter vary considerably in different parts of the colonies. The two classes of septa may alternate with one another in any series, or the larger septa may be separated by an average, in parts even of the same colonies, of 2, 3 up to 8 smaller septa. On opposite sides of the walls the septa may lie against one another but more frequently alternate to some degree; the larger septa throughout are much more frequently arranged contiguous to the smaller, but there is every variation. The septa range from 6—10 in 1 cm.; the series are 1·5—3 cm. wide by 1—2 cm. deep. The longitudinal septa joining calicular centres range from 1—5 in number.

The specimens undoubtedly belong to Symphyllia sinuosa, of which S. grandis appears to me to be only a vigorously growing form, though Ed. and H.'s figure is peculiar. The descriptions (no figures) of S. agaricia, radians, and valenciennesi are not sufficient to separate them, though they may be really different species. The same remark applies to S. subtilis, Rehberg (*Abth. Nat. Ver.*, Hamburg, Bd XII. p. 16, Pl. I. fig. 6, 1892).

Locality. The species is fairly common on the lagoon shoals and reefs of the Maldives. I have also seen it in the outer slope, and it is not improbably in places an important reef-builder. The specimens come from Hulule, Goidu and Minikoi. **Colour** of the Minikoi specimen (fig. 4), a large mass several feet in diameter, in central upper part of the colony, over walls transparent, peristome very light green dotted with dark green, edge of stomodoeum white, and at sides, over walls very dark green, peristome white slate, edge of stomodoeum white.

VIII. Genus *Coeloria.*

Ed. and H., II. p. 411; Klz., p. 15, and Gard., p. 740. Ulophyllia, Ed. and H., II. p. 377; and Quelch, *Report on the Reef Corals of H.M.S. Challenger*, p. 88 (1886).

I still consider that Coeloria and Maeandrina are quite separate genera, the latter having, so far as we know, a true columella, and the former merely trabeculae extending out from the septa to fill up the axial fossa. The species appear to me to fall into three types, which may be best indicated by C. pachychila, daedalea, and magna. C. cooperi shows a transition to the last, which would formerly have been placed in the genus Ulophyllia. The regular method of division of the series, or of the circumscribing of the calices in the genus, is by the enlargement and fusion of septa from their two walls or ridges. The septa on either side in their further growth bend away from the new walls, thus removing to some distance the columellar trabeculae, to which the septa give rise. Later, the new walls themselves get septa, and form the end walls of series or the circumscribing walls of calices. The first part of this process takes place very early in Ulophyllia, but it is no different to what occurs in Coeloria, and the gap between the species of the two genera—if there was any before—is bridged by C. cooperi and magna as well as the Challenger species. Ulophyllia is undoubtedly, so far as its recent species are concerned, a synonym of Coeloria.

Distribution. The genus is the most abundant of all Astraeids on the reef-flat and outside the edge of the reef to 5 *f.*, where the immediate force of the breakers is felt. It also occurs abundantly on the outer slope down to 15 *f.* and one specimen comes from 28 *f.* It may be found occasionally on the sand flat behind the boulder zone, but it evidently loves neither this position nor shoals in enclosed lagoons. **Colour,** generally some shade of green.

9. Coeloria pachychila (Ehrb.). Klz., p. 15, I. 6.

A single half ball-shaped specimen agrees with this species in every respect. The width of the valleys from the tops of the ridges is generally about 7 mm., and depth 5 mm.

Locality. Maldives, brought to me by a native who stated that he obtained it from the Male reef-flat.

10. Coeloria sinensis (Ed. and H.).

Ed. and H., II. p. 416, and Gard., p. 742, XLVI. 3. Coeloria edwardsi, Gard., p. 744, XLVI. 6.

I refer fourteen specimens with some doubt to this species, the mode of which lies much nearer C. edwardsi. The species shows almost as much variation as C. arabica, Klz., but it differs from it in its regularly smaller sized (breadth and depth) calicular rows, which show no tendency to vary in their mode so as to approach C. arabica.

In their characters the specimens vary between the two above-cited species, most rather approaching towards C. edwardsi. The *series* are generally long and increase by their out-pushing at the edges of the colony over its basis of support; subsequently they are divided up by transverse partitions, but, where growth is not luxuriant, this may be compared almost to a process of budding from the ends of the series. Their breadth varies from 3—6 mm., average across parallel valleys 3—4 mm., sinuous valleys 4·2 mm., where growth unfavourable larger but never more than 5 mm. The *theca* is quite perfect, ·5—1 mm. thick varying up to 2 mm. owing to deposition of endotheca. *Septa*, 11—16 in 1 cm. (average of 55 being 13·5), 8—13 reaching columella (average 10·4), ·5 mm. exsert, continuous over walls, square above rather than pointed, finely toothed, precipitous slope to the bottom of the valleys. *Columella* seldom more than 3 mm. below upper edges of theca, at first fused thickenings of septal sides, often at this stage ending in spines flattened parallel to the direction of the valley, and varying with its depth. When a valley is very shallow, owing to boring organisms underneath or other causes, the *columella* may approach in appearance the condition in Leptoria, though generally it is quite inconspicuous. When growth is slow and the valleys are broad, the line of fusion of the septal edges may be joined by additional processes from the septal sides, so that the columella may appear to consist of a relatively broad line of trabecular substance. The *endothecal dissepiments* number 15—18 in 1 cm., but vary in individual specimens.

Locality. Common over the reef-flats of Minikoi and the Maldives; found also on the outer slopes and occasionally on the lagoon shoals.

11. Coeloria daedalea, Ell. and Sol. Gard., p. 741, XLVI. 1 and 2.

Three specimens from Hulule, W. reef and passage through same.

12. Coeloria astraeiformis, Ed. and H. Gard., p. 743, XLVI. 4.

Two specimens from Minikoi, reef-flat and lagoon to the south. This species is possibly only a facies of the last.

13. Coeloria cooperi, n. sp. (Pl. LX. fig. 9.)

Colony massive, with distinct costae but no epitheca showing at the edge. *Series* of moderate length (longest 6 cm.) and twisted, average breadth about 11 mm., 4—9 mm. deep (average 6 mm.), calices rarely circumscribed. *Walls* solid, thin and pointed, often at upper ends a little fenestrated, apparently formed by thickenings of the septal sides. *Septa*, thin,

continuous over ridges, 1—2 mm. exsert, upper ends more or less horizontal up to 5 mm. broad, subequal, about 1 mm. apart, sometimes more crowded, sides granulated; teeth very irregular, often small above, near the bottom of the valley passing into fine pointed teeth or into blunt upstanding lobes, the latter from opposite ridges often fusing and forming the first stages of the division into separate calices. *Columella* varying greatly in amount in the valleys, being cut up where opposite septa fuse, either formed of the innermost pointed teeth or of rounded trabeculae from most of the septa, always very loose and open. In *section* endothecal dissepiments thin, very oblique 1—2 mm. apart, often at edge or where growth is unfavourable causing the walls to appear exceedingly thick, extending up to within 2 mm. of the edges of the septa.

The colony is very peculiar in the frequent fusion of large septa across the bottom of the series. The septa on either side of these may curve a little away from them thus giving an appearance in some parts of the series of the calicinal centres being distinct.

Locality. A single specimen, the edge of a large flattened mass from the west reef of Hulule, showing a much rounded living surface of 38 by 19 cm.

14. Coeloria magna, n. sp. (Pl. LX. figs. 7 and 8.)

Colony massive, underside, up to within 1 cm. of the edges, clothed with wavy epitheca, at edge strongly costate. *Series*, short, longest 4 cm., average breadth about 15 mm., very shallow, almost superficial or up to 7 mm. deep, calicular centres generally distinctly recognisable. *Walls* thin at edge, in most parts appearing very bluntly pointed, and thick below owing to the oblique character and superficial position of the top exothecal dissepiments. *Septa* thin, continuous (in some parts very irregular—often thickened almost vesicular—owing to boring animals or small cirripedes), irregularly exsert (about 1 mm.), generally pointed, but with scattered septa flat-topped (3 mm.) up to 3 mm. high, about 40 round a circumscribed calice, from 6—10 in 1 cm. in accordance with the presence or absence of minute septa alternating with the larger, more crowded at edges of colony, sides granular; teeth minute, towards the inner ends of the smaller septa more pointed and longer, merging into blunt, often two or three toothed paliform lobes on 12—18 of the septa of circumscribed calices; in the series septa occasionally joined across the valleys, dividing them up into fairly distinct calicinal centres. *Columella* small, sometimes formed of the innermost pointed teeth but more often of rounded, very lax trabeculae from at least half of the septa. *Endothecal dissepiments* oblique to 30°, thin, 1·5—2·5 mm. apart, rather vesicular.

The species, even more markedly than the last, shows the division of the valleys into separate calices by the fusion of the larger septa from either side. It differs from Ed. & H.'s species of Ulophyllia as described and figured. With the Challenger specimens, which seem to me to be of one species, it has greater resemblances, but its shallow cells, breadth of series, and septal characters serve to separate it, so far as our knowledge of variation at present goes. Figs. 7 and 8 show two different parts of the colony.

Locality. Addu, outer slope, 28 *f.*, a flattened massive colony, 41 cm. long by 27 cm. broad and 7 cm. thick.

IX. Genus *Leptoria*.

15. Leptoria gracilis, Dana.

Dana, p. 261, XIV. 6; Ed. and H., p. 407; Klz., p. 13, II. 5, IX. 11*a*—*d*; Gard., p. 739.

Four specimens belong to this species. They differ from Dana's description and my own Rotuma specimen in being everywhere more delicate, septa less exsert and rough, and all parts thinner. They show little variation, and that mainly due to the presence of boring animals, all kinds of which appear to love their corallum; from this cause the fused theca may appear thick, in section hollowed out, and the plates of the columella thick and pushed up so as to reach the level of the top of the theca. The surface is studded with the round holes of a crab, Cryptochirus, but barnacles do not occur.

Locality. Rather sparsely distributed, especially at Minikoi, mainly reef-flat and outer slope, a specimen from a shoal near the W. passage of Minikoi, and specimens from Hulule and Goidu. **Colour,** brown with green lines, where the peristome series occur.

X. Genus *Hydnophora*.

The several species of this genus show perhaps as much variation as those of any other in the collection. I did not, however, study the variability of its colonies *in situ*, the genus being rare at Minikoi, and I have no notes on the variation of the specimens in the British Museum. Although I have more than 50 specimens before me I am quite unable to determine with any certainty out of all the species mentioned by Ed. and H. and Klunzinger, more than H. microcona. H. maldivensis would appear to be a truly explanate form, but I have explanate and massive specimens of H. lobata below, which as also the lobed forms in places approach H. microcona. There are, however, no intermediates, though all as well as the specimens of H. microcona grew in more or less the same environment. This fact then suggests that of H. microcona we have two real varieties, *i.e.* explanata and lobata.

Distribution. The genus is found on any reefs in the Maldives, and we observed it forming considerable masses on the outer slope of Goifurfehendu Atoll. It may hence be an important reef-builder. It varies in depth to 32 *f.*, the deeper specimens very markedly differing from all described reef-forms.

16. Hydnophora grandis, n. sp. (Plate LX. fig. 11.)

Colony massive and thick but exceedingly light, edges explanate but coarse, clothed underneath by a thin epitheca. *Monticules* ending above in fine points or in thin plates, in the colony not more than 6 mm. long, 2—3 mm. high, varying from 4 to 9 mm. wide from valley to valley, average about 7 mm. The *septa* on the monticules number from 6 to 18, the most pointed 6 or 8, those most elongated 14—18, mode 10 or 12; they are not exsert, slightly granular at the sides, rough edged but not toothed, and appear more distinct than in any other species owing to the lowness and breadth of the monticules; around calicular centres the septa number 6 or less. There is no definite *columella* but the septa at the bottom of the valleys bend towards the calicular centres, and may be thickened, while between the lower ends sometimes rough pillars arise, especially where the septa round a centre number less than six. *In section* the monticules are seen to have the very thin, narrow or

broad theca in the centre, from which the septa appear to radiate; the loculi are filled up with vesicles or cells not more than ·75 mm. apart and scarcely longer, extending to within 1 mm. of the edges of the septa; the valleys are filled up in the same way but with rather larger vesicles, so that there is obviously no columella.

The species differs from all others in its large monticules and few septa, as well as its light structure. The theca is very difficult to see in section; it is often a mere rod from which the septa radiate as from a rod-like columella.

Locality. S. Nilandu, 25 *f.*, and Haddumati, 32 *f.*

17. Hydnophora microcona, Lmk. Ed. and H., II. 423, and Gard., p. 744.

There are nine specimens of this species in the collection. It is fairly common, though rather local, throughout the Maldives, but scarce at Minikoi, where it was only obtained from the reef-flat. The Maldive specimens were collected at Hulule, Goidu, Addu, and Turadu (S. Mahlosmadulu) from reef-flat and lagoon. **Colour,** olive green, polyps noticeable for their large amount of mucus.

18. Hydnophora ?lobata (Lmk.). Ed. and H., II. p. 421.

Two moderate sized specimens, the largest 17 by 14 cm. by 13 cm. high, may belong to this species. They are extraordinarily variable on their thin edges, lobes and valleys, in parts appearing to represent a lobate variety of C. microcona, but I have seen no intermediates.

Locality. Two specimens from the west reef of Hulule. [H. lobata mihi (p. 745) from Rotuma is probably not the same species as the above specimens, though it resembles them in its light texture. H. exesa mihi (p. 745) from Funafuti is probably a new species.]

19. Hydnophora maldivensis, n. sp. (Pl. LX. fig. 12.)

We dredged 27 pieces, all small, of an explanate coral of this genus, which I am bound to refer to a new species. It comes close to H. gyrosa, Ed. and H., but the only indication of lobing that it gives is in an elevation over two barnacles 15 mm. high by 12 mm. broad. Even in its thickest part it is less than 10 mm., averaging in different parts 3—6 mm. Its characters are as follows:

Colony, explanate, thin, covered underneath to within 1 cm. or so of the edge with a delicate epitheca, through which the ridge-like, untoothed costae (14 in 1 cm.) are clearly visible. *Monticules* towards the centre of the colony more rounded and much larger, 2—3 mm. high and 6—7 mm. between the valleys, passing gradually into long (6—7 cm. at edges), slightly sinuous collines 1—2 mm. high and 4—5 mm. broad, separating series of calices, of which the centres are not visible except near the centre of the colony, where they have generally 6 septa; theca only visible in places as a thin line. *Septa* not exsert, near the edges sloping up very obliquely on the walls of the series, subequal about 1 mm. apart but sometimes alternating with very minute septa; teeth not noticeable near upper edges, within very low, distant and blunt. *Columella* a few irregular, rough, twisted trabeculae from the lower ends of the septa, varying considerably in amount, in some places forming a distinct base to the valleys, but in others very irregularly massed, probably not a true columella. *In section* extremely vesicular, the vesicles extending to within 1 mm. of the edges of the septa and forming the monticules; theca not visible.

Locality. S. Nilandu, 24 *f.* and 30 *f.*, Haddumati, 32 *f.*, and Suvadiva, 25 *f.*

XI. Genus *Favia*.

Ed. and H., II. p. 426. Klz., p. 25. Astraea, Gard., p. 747.

The genus is in many respects a most unsatisfactory one. On the one side it almost merges into Coeloria (*vide* C. astraeiformis, Ed. and H.), and on the other into Goniastraea. Indeed, many species are in parts at any rate indistinguishable from the latter, save in microscopical sections. Again, Orbicella approaches close to it in that some of its species show fission moderately freely and some intracalicular gemmation (which may simulate fission) as well as the more regular extracalicular. The presence of a valley or sulcus between the corallites is really no test, and the septa are often continuous in Orbicella between the calices and within the walls.

The species in the collection are most variable, even more so than those of Orbicella and Prionastraea. Attention may be particularly drawn to F. denticulata, in 16 specimens of which I have attempted to work out the variability, both normal and vegetative, and also to F. hululensis. The species fall naturally into three groups: (*a*) those with rather rounded calices, sulcus on walls, theca distinct, paliform lobes more or less prominent, and exsert portions of septa generally horizontal; (*b*) angular calices, thin walled and no sulcus, marked paliform lobes, exsert parts of septa rounded or rough; and (*c*) gyrose calices. No. (*a*) includes F. cavernosa, denticulata, hululensis and hombroni, a very close series, a gap in size only between the last two, with offshoots in F. affinis and laccadivica. In (*b*) we have F. halicora and parvimurata, which might almost be placed in Goniastraea, and in (*c*) F. versipora and adduensis, the former particularly recalling certain Coeloria.

Distribution. The genus is essentially dominant over all other massive forms on lagoon shoals in Minikoi and throughout the Maldives; it is also, with the possible exception of Prionastraea, the most abundant in the waters of the outer slope to about 15 *f.* It is seldom found on the reef-flat, and generally shuns all sandy spots, or where sediment may collect. Its colonies on the lagoon shoals of Minikoi form enormous, overhanging masses, several feet in thickness, often dead in the centre but living on the sides. Numerous boring organisms, particularly Sipunculoids, find a home in its coralla, but seldom distort its surface. Only one specimen was dredged, that of F. adduensis, from 25 *f.* **Colour** of the living colonies almost invariably some shade of green.

20. Favia versipora (Ehrb.).

Favia ehrenbergi = F. versipora (Ehrb.), Klz., p. 29, III. 5, 7 and 8, and IX. 1 *a* and *b*. Favia bertholleti, Ed. and H., p. 431.

A single specimen from the edge of the reef at Minikoi belongs to Klunzinger's typical form of this species. Its walls are, indeed, more rounded, septa thicker and less numerous (18 to 26), and calices rather smaller, but these appear to me to be vegetative variations. Here and there I find a calice with its septa having relatively long teeth, and this fact, coupled with the number of septa, causes me to consider F. bertholleti to be merely a synonym, as indeed I deem all those suggested by Klunzinger.

21. Favia adduensis, n. sp. (Pl. LXII. fig. 6.)

Colony massive, or somewhat incrusting. *Calices* irregular, seldom rounded, angular, elongated, twisted or gyrose, largest 10 by 5 mm., average 6 to 7 by 4 mm., 3 to 4 mm.

deep. *Walls*, either—over the greater part—rounded or slightly pointed above, not more than 1·5 mm. thick, with septa ·5 mm. exsert, not generally extended horizontally, continuous between calices, or—a few places at the edges—3 mm. or more thick with distinct furrows but theca never visible. *Septa* irregular, often 2 or 4 (presumably primaries) very much thicker (·5 mm.) with exsert parts horizontally extended—evidently showing where division is ultimately to take place—in the average calice about 21 in number, often the smaller curving round to fuse with the larger, all thin with the exception of the large primaries, granular on the sides, finely but very irregularly toothed, the lowest teeth of about 12 of the largest rough, pointed and perpendicular, forming a more or less conspicuous pali-crown. *Columella* always distinct, rather dense, commonly at least a quarter of the breadth of the calice, formed by finely anastomosing trabeculae from at least one half of the septa. *In section* (which is not very clear) the exo- and endothecal parts appear rather vesicular, walls compact.

Locality. From the outer slope of the reef of Addu, 25 *f.* The specimen (15 × 11 × 7 cm.) is more or less incrusting and relatively thin. The species is nearest allied to the last, but markedly differs from all known forms of the genus.

22. Favia cavernosa (Forsk.). (Pl. LXI. fig. 13.) Klz., p. 26, III. 4.

I refer to this species a rounded mass, 22 cm. in diameter, dead in centre but surrounded by a belt 14 cm. broad, still living when obtained, and a second, dead in places, 15 cm. in diameter by 13 cm. high. The second has rather thinner walls, higher calicular edges, thicker costae and septae than the first. Both, especially the second, show recognisable, paliform lobes in a few calices. The septa may be thickened or not, where they join the theca. Traces of costae without corresponding septa are often present. Only in isolated calices can the columella be termed "sehr wenig entwickelt," being generally nearly as well marked and of the same nature as in F. denticulata.

There appears to me to be little or no doubt as to the identity of these specimens with Klunzinger's species, the figure of which is good. I accept the latter's synonymy, but I am doubtful as to Favia okeni.

Locality. Minikoi, larger from the flat behind the boulder zone, and smaller from a lagoon shoal.

23. Favia affinis Ed. and H. (Pl. LXII. figs. 22 and 23.)

Ed. and H., II. p. 429. Gard., p. 750.

Three quite small specimens with ordinary calices (not undergoing fission) varying up to 13 mm. long and 9·5 broad, and walls up to 3 mm. in thickness but averaging about half this. The *theca* of the separate calices is not generally distinct, their exothecal connections usually in the form of vesicles, convex above, and not mere dissepiments. The *septa* are 1 to 2 mm. exsert above the theca. The line of junction of the costae of neighbouring corallites is shown by a very distinct notch or furrow, and in this position delicate, transverse connections tend to form between them, where growth is vigorous. The edges of the septa over the theca may be thickened, and are edged with fine teeth. They vary in number up to 30, of which about half extend into the calice to form with fine, twisted trabeculae from their edges a small *columella*, against which they end in relatively thick, blunt, often spined, paliform teeth.

The septa, where they pass into the theca, are often quite hollow. The endothecal dissepiments, distant 1·5 to 2 mm., commonly extend downwards from the theca at an angle of about 45°. All parts tend to be excessively thin and delicate, though the hollow, rough nature of the septa, together with their small number in the large calices, gives the species a coarser and more open appearance than any other in the collection. It differs in the vesicular exotheca (difficult generally to distinguish, chambers about 1 mm. high) from F. cavernosa, the possible variation of which in most other points might well cover it. Its form of growth is bigger but otherwise closely related to F. denticulata.

Locality. Hulule, W. reef (calices slightly smaller than in the other specimens, distinct furrow, septa less exsert but thicker edged, paliform lobes less marked), Minikoi, lagoon shoal (very light and of most vigorous growth) and a doubtful fragment from the reef-flat.

24. Favia denticulata (Ell. and Sol.). (Pl. LXI. figs. 14—18.)

Madrepora denticulata, Ell. and Sol., *Zooph.* p. 166, pl. 49, fig. 1 (1786), Favia denticulata, Ed. and H., II. p. 428 (non Astraea denticulata, Dana, p. 234, 1846, Gard., p. 748), Favia denticulata, Klz., p. 27, 1879. ? syn. F. urvilleana, F. doreyensis, F. geoffroyi, F. aspera, all Ed. and H.

The characters of this extraordinarily variable species are as follows: *Colonies* very markedly massive in growth, closely incrusting at edges with a quite determinate, transversely marked epitheca. *Walls* always with upper edges of theca distinct and slightly raised above the top dissepiments, 2 to 4 mm. thick. *Calices* always rounded, elongated, or a little distorted where dividing, often somewhat oval, average size varying from 6 to 10 mm. in diameter and 2 to 6 mm. in depth. *Costae* commonly continuous between calices, always sloping below level of top of theca (hence very distinctly furrowed appearance, or series of notches on the walls), and equal in number to the septa, but sometimes additional ones marked by fine linear ridges or lines of granules or spinules (especially where septa are less numerous). *Septa* always somewhat exsert (·5 to 2·5 mm.), always arched above, upper end almost horizontal, 20 to 40 (generally 24 to 34) in number, no distinct cycles, outer halves almost perpendicular, closely set with small, fine, subequal teeth, commonly on 10 to 20 of the larger septa passing below into 1 or more upstanding paliform lobes, or at least ending perpendicularly against the axial fossa. *Columella* $\frac{1}{4}$ to $\frac{1}{5}$ breadth of calice, flat-topped, spongy, formed by very fine, much twisted trabeculae from the 10 to 20 larger septa. *In section* exothecal dissepiments 1 mm. apart, horizontal, endothecal same, often rather oblique to 50°.

It will be obvious even from the above description that the corallum varies extraordinarily in external appearance, a form with calices averaging 10 mm. in diameter by 5—6 in depth, with marked furrows, thick, rough septa with broad, paliform lobes, superficially having little resemblance to one averaging 7 mm. by 3 mm., no furrows, thin, smooth septa and little or no paliform lobes. Yet all are clearly joined by their distinct, never angular nor gyrose calices, thick walls with larger or smaller furrows above, septa arched and of similar shape, mode 25 to 29, and spongy columella. In my specimens all other characters show variation, a little in each colony but in most characters far more in the series. Any one character may become definitely fixed *in any locality* in any type of the series and give a definite species. I affix a name and a list of synonyms, but I recognise my temerity in so doing partly for the above-mentioned reason, and partly because the descriptions commonly given by older authors were quite inadequate, often from single specimens or from unknown localities.

The only purely vegetative variations appear to me to be thickness of walls, distance apart, obliquity and thickness of dissepiments, degree of spinulation of faces of septa and costae, though all others undoubtedly show a certain amount of this class of differences. In the accompanying Table I have attempted to show the variations for the average sized corallites of the several specimens, taking in each case what appear to be their most vigorously growing, *i.e.* upper surfaces, and finding the average size from a measured patch (excluding obviously young forms) and in each measurement taking an average. Some of the smaller specimens are young colonies.

Locality. Found commonly everywhere in the Maldives and in Minikoi, on the outer slope, any flat reasonably bare of sand and on the lagoon shoals. Nos. 1 and 2 in the Table have septa thickened up to 1 mm., where they pass into the theca. **Colour,** brown to green, darker over walls.

25. Favia laccadivica, n. sp. (Pl. LXII. fig. 24.)

Colony massive, edges closely encrusting, thick transversely marked epitheca. *Walls* thick, except where fission taking place, generally not less than 2 mm., top exothecal dissepiment level with top of theca. *Calices* always rounded, often oval, average diameter in different parts 8 to 9 mm., depth 2·5 to 4·5 mm. *Costae*, equal, finely toothed, almost flat-topped between calices (no notch), slight tendency to join transversely, on thicker walls smaller costae often shown by a few or a row of spines, represented by septa IV. *Septa*, 1 to 1·5 mm. exsert, very flat-topped, 4 cycles, not very distinct or regular, 12 to 16 reaching columella, 12 to 16 intermediate, equal in thickness, two-thirds way to columella, often fusing to the first series, and 24 to 32 generally minute, angular ridges between the larger, often wanting; septa I., II. and III. fine pointed teeth, not crowded, passing into ridges on their slightly granular sides, commonly 12 to 16 with the lowest a larger pointed tooth rising about 2 mm. above the fossa, forming a pali-crown. *Columella* quite distinct, $\frac{1}{4}$ width of calice, flattened twisted plates from about 12 septa. *In section* exothecal dissepiments thin, flattened or arched, the convexity above, 1 mm. apart, endothecal thin, oblique (60°), 1 to 1·5 mm. apart.

The specimens are very markedly different from any other Favia I have in the collection owing to the great regularity in thickness of all their parts, exsertness, teeth, etc. of the septa and the complete absence of a furrow. I cannot find any described species, which in any way resembles it. The specimens show singularly little variation, those on the sides merely have thicker walls and costae IV. accordingly more distinct.

Locality. Three specimens from lagoon shoals, Minikoi. **Colour,** grey over walls, dark green peristome.

26. Favia hululensis, n. sp. (Pl. XLI. 19—21.)

I refer four massively growing, complete colonies and two smaller pieces to this species. It differs from F. denticulata in the following characters: *Walls*, thin (1 to 2 mm.), theca very distinct above the top exothecal dissepiment. *Calices* more compressed, sometimes angular or oval, average size 5—7·5 mm. in diameter, 3—4 mm. deep. *Costae* continuous between calices, notched, generally no furrow, sometimes traces of transverse connections, equal in number to *septa*. Latter ·5—2 mm. exsert, flat-topped, about 20, cycles more or less distinct, outer part of slope perpendicular; teeth variable, on the exsert part small, pointed, round, and inside the calice generally none or only 2 or 3, small, well separated and pointed, often the lowest on 6 to 8 of the larger septa blunt, paliform, otherwise these septa perpendicular against axial

TABLE OF MEASUREMENTS
of sixteen specimens of Favia denticulata and five of Favia hululensis.

Number	Size of Specimen in cm.			Diameter of calice in mm.	Depth of calice below theca in mm.	Exsertness, septa over theca in mm.	Total septa	Septa joining columella	Paliform lobes *	Locality
	Length	Breadth	Height							
1	16	12	10	9·3	3·2	1·6	29	19	R P	Minikoi, sand flat
2	15	10	9	9·5	4	1·5	29	17	R	„ lagoon shoal (fig. 14)
3	18	16	11	9	5	2	30	14	D F	Goidu, behind boulder zone (fig. 15)
4	15	9	10	8·8	5	1·8	29	14	?	„ outer slope
5	8	4	3	8·6	4·5	1·7	29	14	?	„
6	10	8	6	9·1	4	1·8	29	15	D P	Hulule, sand flat
7	15	13	9	8·4	3·5	1·5	28	14	D P	Minikoi, lagoon shoal
8	18	13	11	8	3·5	1	24	11	D P	„ (fig. 16)
9	19	15	10	7	3·2	1·2	27	14	R P	„
10	21	18	11	6·8	2·8	1·2	26	14	D P	„ (fig. 17)
11	9	6	7	8	3	1·5	26	14	D F	Hulule, west reef
12	7	6	5	7·5	2·6	1	26	13	0	„ east reef flat
13	15	13	13	7·3	3	1	22	9	0	„ passage (fig. 18)
14	15	7	10	8·3	3	1	24	12	C P	Minikoi, sand flat
15	6	7	5	6·3	3	1·5	22	11	C P	„ reef flat (Young)
16	8	6	5	6·3	3	1	20	13	D F	Goidu, reef flat (Young)
1	11	10	8	5·5	2·5	1·5	20	9	R P	Hulule, west reef (fig. 19)
2	22	15	11	5	3	·75	18	8	0	„ south reef (fig. 20)
3	5 / 4	3 / 3	3 / 2	6	2·5	1·25	19	10	R P	„ east reef flat
4	10	9	7	6	4	·75	22	8	0	„ passage (fig. 21)
5	7	7	5	5·5	3·5	1·25	17	8	?	Goidu, reef flat

* R=recognisable, D=distinct, C=conspicuous, P=pointed, F=flattened.

fossa. *Columella* not more than $\frac{1}{6}$ breadth of calice, generally very small, often rudimentary, formed by the much flattened trabecular ends of 6 to 8 septa. *In section* rather massive, exothecal dissepiments thick, 1 mm. apart, endothecal thin, horizontal, about 6 mm.

The species is rather like a small edition of F. denticulata, but differs in its thin walls, number of septa, number of septa forming the columella, and character of last. The specimens show similar variability, and I likewise enumerate them in tabular form. No. 1 differs somewhat from the rest; it has some rather larger calices with very exsert septa, and a greater number reach the columella and have paliform lobes, but these differences are due to the fact that the colony is evidently growing very vigorously and its corallites rapidly dividing. No. 4 is possibly a little doubtful on account of its deeper calices, septa larger in number (last 6 to 10 exceedingly minute), little exsert (·75 mm.), costae little notched and transversely connected; it is growing on a column of horny sponge, 10 cm. high by about the same thick, which itself was attached to a muddy bottom.

27. Favia hombroni (Rousseau). (Pl. LXII. fig. 27.) Ed. and H., p. 435.

Two specimens which differ only in not being "en masse gibbeuse et sublobée," but massive and rounded and in the columella not being "assez distincte," but the distinct, rather flattened, trabecular junctions of about 6 septa. I give certain characters of my specimens.

Calices rounded, oval or angular, averaging about 3 mm. in diameter, though varying up to 6 mm., theca generally quite distinct above the top exothecal dissepiment. *Walls* ·75—1 mm. thick, except at the edges, where this may be doubled, covered by thin, smooth, sub-equal *costae* (·5—·75 mm. exsert), continuous between calices, horizontal, no furrow nor distinct notch. *Septa* almost smooth-sided and thin, cycles I. and II. and about half of III., scarcely visibly toothed, I. rather broader over wall and with a crown of fine, pointed, paliform teeth, often joined by 1 to 3 septa of cycle II. *Columella* generally as above at the surface, underneath much larger and of a more solid appearance.

Locality. Hulule passage, a small colony 10 by 8 by 7 cm., and Minikoi, almost in boulder zone, a head dead in the centre.

28. Favia halicora (Ehrb.) Klz.

Goniastraea halicora Klz., p. 32, IV. 1 and 2, and X. 3 *a* and *b*.

Four specimens, two large ones approaching *forma obtusa* Klz. and two pieces with smaller calices rather more doubtful, more like *forma acuta* Klz., the pali in reality being only teeth and the theca of neighbouring calices not fused though the walls are very dense, perhaps almost solidified by the exotheca.

The specimens are as follows: (1) half a large head, 22 cm. wide, 13 cm. broad, and 18 cm. high, walls rounded, though not so much as in Klz.'s fig. 1, septa 28 to 36, half with blunt, thick pali, Minikoi, lagoon shoal; (2) a colony dead above, 16 × 14 × 8 cm., part like last, part very obtuse walls, columella then often papillated above, Minikoi, inner part reef-flat to south; (3) a colony, 8 × 6 × 5 cm., calices about 8 mm., very rapidly dividing, resembles part of (1) but nearer *acuta* in walls, Turadu, S. Mahlosmadulu, reef-flat; (4) a colony 12 × 6 × 6 cm., calices 7·5 mm., rapidly dividing, very acute walls, Goidu, reef-flat.

29. Favia parvimurata, n. sp. (Pl. LXII. fig. 25.)

Colony massive, covered underneath by a thick, transversely marked epitheca. *Calices* generally pentagonal or hexagonal, 8—12 mm. (mode 9—9·5 mm.) in diameter, 3 mm. deep or

less. *Walls* exceedingly thin at edge, sometimes fenestrated or not completely formed, thicker below but except at the edge of the colony not more than 1 mm., covered by the continuous unnotched, rather pointed and strongly toothed, exsert (1—2 mm.) ends of the *septa*. Latter, 16—26 (average 21) in number, generally hollowed where they pass through the walls, rather thick, with rough granular or spiny sides, a few coarse, pointed teeth, about half ending against the axial fossa with great, thickened and pointed teeth, or all variants to a thick, perpendicular edge or thick teeth merging into the *columella*. Latter $\frac{1}{4}$ to $\frac{1}{6}$ diameter of calice, formed by the anastomosis of flattened trabeculae from half to two-thirds of the septa (as many as can crowd round the fossa), commonly ending above in more or less flattened rods. *In section*, walls almost solid save for spaces due to the hollow septa, endothecal dissepiments very oblique, 30° to wall, thin, 1—2 mm. apart.

Locality. Hulule; reef-flat to east. The species approaches closest perhaps to F. halicora (Ehrb.), but the wall, largely formed by the lateral fusions of the hollow septa, is exceedingly remarkable.

XII. Genus *Goniastraea*.

Ed. and H., II. p. 444, and Gard., p. 746.

By the removal of G. halicora I have restricted the genus to forms of which the theca of neighbouring calices completely fuse, and which have true pali, not mere paliform teeth.

The genus is of little importance from its number of species, but possesses in G. retiformis a form of wide distribution and great importance on the coral reefs of the Maldives, and so far as I saw, of still greater abundance off Ceylon, both at Tondimanar and also at Weligama.

30. Goniastraea retiformis (Lmk.). Klz., p. 35, IV. 5, G. eximia Gard., p. 747.

I refer fourteen specimens to this species, which I have no doubt Klunzinger has identified correctly. The *columella*, which he does not describe, appears in some of the specimens like a small solid mass in the centre of the calice, but in others is clearly made up of a dense mass of trabeculae from the paliform septa. My specimens vary somewhat in the size of the calice, averaging about 4 by 3 mm., the longest not as yet showing division being 6 by 4 mm. The *pali* average in different specimens 7, 8, 9 or 10, but 8 is the mode; occasionally they are not present as upstanding rods, but yet are clearly represented by the much thickened edges of the septa. G. eximia from Fiji, Rotuma, etc. is the same species, but the mode of its pali is 9 or 10, and its appearance in section is rather more delicate than in most of my specimens.

Locality. This golden-green coloured species is common on the outer slope, occasionally occurs on the reef-flat in small heads, and is abundant in the lagoon both at Minikoi and in the Maldives. It often forms immense masses, which on the shallow flat behind the boulder zone die in the centre but spread linearly, the blocks in growth resembling massive Porites. Two specimens came from the passage into Hulule.

31. Goniastraea solida (Forsk.). (Pl. LXII. fig. 28.) Ed. and H., II. p. 455.

A specimen agrees in every respect with the description of this species, which is not, as Klunzinger supposed, synonymous with G. pectinata or G. favus. It resembles the first

in the columella and in the nature and shape of its septa, but their upper edges over the theca are often rather pointed than flattened. The pali are the thickened, perpendicular, inner edges of 8—12 septa. The endothecal dissepiments are thin and practically horizontal, generally ·5—·6 mm. distant, seldom or never more. The walls in section are about 2 mm. thick, but on the surface in any rapidly growing part may be quite thin, evidently thickening later by a deposition of solid endotheca between the septa.

Locality. A single specimen from the passage at Hulule. It is No. 5, p. 331 of Vol. I. of this publication; its specific gravity 2·11 is greater than that of any other Astraeid that I have taken.

32. Goniastraea pectinata (Ehrb.). Klz., p. 34, IV. 6.

Three specimens, the third very small, are undoubtedly referable here, though Ehrenberg's specimen is, I consider, scarcely typical of the species. The *wall* is thin, though the whole ridge with its very slightly exsert (never more than ·5 mm.) septa, horizontally edged above, varies from 2 to 4 mm. The *septa* are occasionally very thin, but in most parts, to the lens, appear rough-sided and relatively thick; they are more often continuous between calices than alternating, and are subequal in size, but in some places very rudimentary ones of cycle IV. are found between the larger. The *pali* are rough sided plates in front of, but not in surface view connected with, the septa; their number varies with the length of the corallites, but in rounded calices their mode is 10 or 11. At the edge and on the under side of the colonies the walls may become much thicker, but the whole ridge (including the septa) varies but little; the pali sometimes are spiniform. The *columella* is merely the junction of the paliform septa to one another, and may be scarcely visible, plate-like or obviously formed by flattened trabeculae.

Locality. Goidu, reef-flat, Turadu, S. Mahlosmadulu, flat behind boulder zone, and S. Male, 18 *f.* The latter is a little colony with 35 rather shallow calices, with very thick walls (3 mm.) having traces of a grove.

33. ? Goniastraea favus (Forsk.). Klz., p. 34, IV. 4 and X. 7.

The broken-off edge of a colony, 7·5 × 3 cm. by 4 cm. thick, possibly belongs to this species, with the characters of which it is in general agreement. It does not show clearly its mode of increase though sections lead me to believe that it is by fission. The specimen was dredged from 20 *f.*, Suvadiva.

XIII. Genus *Aphrastraea.*

34. Aphrastraea deformis (Lmk.). (Pl. LXIII. fig. 31.) Ed. and H., II. p. 452.

I refer four specimens to this species, nos. 1 and 2 of which agree closely with one another and correspond in all described characters with the species and also genus, of which it was in Ed. and H.'s catalogue the sole representative. The *walls* have a distinct theca which may show as a very thin, polygonal ridge between the calices, but their greater part is formed by the small vesicles or cells of the endotheca, which rise to within ·5 mm. of the upper edges of the septa; they thus appear enormously thick up to 5 mm. The *septa* are continuous between the calices or stop at the theca; they lie in four cycles of which I. and II. typically have rough upstanding, pointed, paliform lobes, though II. is not in this respect always complete. Septal cycles III. and IV. are scarcely separable and mere little

spined ridges between the larger; more than half of IV. is seldom present. The teeth of all are rough, low, saw-like but not crowded, rather irregular. The *columella* is formed of flattened trabeculae from septa I. and II.

Locality. (1) A flattened mass 8·5 × 3 cm. by 4 cm. thick, Minikoi, coral flat near Wiringili; (2) a similar mass 14 × 12 cm. by 4 cm. thick, Suvadiva, 40 *f.*; (3) a flattened piece of a colony, deformed with barnacles and worms, 7 × 6 cm., with smoother septa and rather deeper calices, and with endotheca more solid, Suvadiva, 20 *f.*; (4) a flat, thin, rough, little colony with wavy epitheca underneath, 4 × 4 cm., quite similar to 1 and 2 but rougher in appearance owing to the longer septal teeth, cycle IV. larger and more regular, often cycles fusing, columella relatively larger, South Male, 30 *f.*

XIV. Genus *Orbicella.*

I must still assert my inability to find characters which clearly separate Plesiastraea and Leptastraea from this genus (*P. Z. S.* 1899, p. 751). Generic characters are presumably more ancient than specific, or at any rate have become absolutely fixed. Such may be crystallising between the three genera, but at present the process is quite incomplete.

Distribution. The genus has two very common reef-species, O. ehrenbergana and transversa, capable of living absolutely under the breakers where also O. annuligera dwells. O. laxa forms great masses on the lagoon shoals at Minikoi, where O. minikoiensis is very common in one small area. One specimen of the genus was dredged, but that from 4 *f.* only. *Colour* invariably some shade of green.

35. Orbicella annuligera Ed. and H.[1] (Pl. LXIII. fig. 32.) Ed. and H., II. p. 471. Astrea annularis Q. and G., *Zooph.* p. 210, Pl. 17, figs. 17—18, 1833.

Four specimens correspond in every respect with the above descriptions. The septa and costae are rough and the latter thick, septal teeth very low except the innermost, which is always paliform, thickened and pointed, the series forming a well-defined crown 1—2 mm. above the columella. Ordinarily 12 fuse in the centre of the calice and have paliform lobes, but in the larger corallites there may be 14 or 16, the increase entailing the presence of septa of the fourth cycle. The columella is dense, formed by trabeculae from the septa, which often fuse even outside the level of the pali so that the latter may appear to arise from its surface. The corallites vary up to 7·5 mm. in diameter and the calices to 4·5 mm.

Locality. Minikoi, reef-flat, and Goidu, E. reef, breaker zone. The former specimens have deeper calices, in some places a little distorted, and smoother septa and costae than the latter. All are quite thin and small, mere living fragments, probably of once much larger spreading masses. **Colour** a brilliant yellow all over.

36. Orbicella minikoiensis, n. sp. (Pl. LXIII. fig. 35.)

Colony massive, under the overhanging edges longitudinally ridged costae, no distinct epitheca. *Corallites*, 11—14 mm. in diameter, almost flat, often somewhat distorted by the intercalicinal budding. *Calices* generally round, 8—10 mm. in diameter, varying from flat to

[1] I fully accept Vaughan's synonymy of O. acropora, *U.S. Fish Commission Bulletin*, vol. II. p. 301, 1900. The specimens identified by me from Rotuma are rather different from the present ones of annuligera, but scarcely exceed the limits of its variability. There is a close connection between the two species, however, and one could have wished that Vaughan, after having made certain of O. acropora, had redescribed it.

2 mm. in depth. *Walls* up to 3 mm. thick, sharp edged against the interseptal loculi but no distinct theca, slightly grooved in the centre. *Septa* much thicker, up to 1 mm. where they pass through the theca, slightly different in size, those of the lowest (I. and II.) cycles largest, 1—3 mm. (commonly about 2 mm.) exsert. *Costae* relatively thick, with low blunt teeth, sometimes passing from calice to calice, but always with a distinct notch over the furrows of the walls. *Septa* varying in number, typically 24, thinning out within the calice, alternately larger and smaller, with granular sides; each provided with about six bluntly pointed teeth, the third or thereabouts often longest and sometimes representing the most exsert portion of the septum, no distinct paliform teeth, sometimes tertiaries fused to secondaries or primaries, otherwise all merging below into the *columella*. The latter ranging in size from one-third to one-half the diameter of the calice, from the surface looking fasciculated, but really formed by coarse, anastomosing and uprising trabeculae from the septal edges. *In section* the walls appearing relatively compact, partly owing to thick costae but also to the relatively thick, horizontal, exothecal dissepiments, endothecal dissepiments sloping into the columella at an angle of about 55° to the thecal walls, about 1 mm. apart, rather varied. *Increase* only by intercalicinal budding.

The form is most distinct owing to its very shallow calices, large columella and thick, exsert septa. The only real variation is in the depth of the calices, those near the edges being rather deeper. Of Ed. and H.'s species the specimens are closest to O. lamarckana, but the costae are different.

Locality. Minikoi, three specimens, not common, sand-flat behind boulder zone to west and south of the atoll.

37. Orbicella laxa Klz. (Pl. LXIII. fig. 33.) Klz., p. 49, v. 3 and x. 9.

Four specimens closely corresponding to the above description and the sections shown in Pl. X. fig. 9, but differing from Pl. V. fig. 3, in having a considerably more solid and massive appearance with calices a trifle larger (8 mm.). Budding in my specimens is intra- as well as extracalicinal.

The corallites vary considerably. In the most vigorously growing parts their thecal edges may be upstanding (calices 4 mm. deep from top of theca to top of columella); septa very thin, 1—1·5 mm. exsert, about 18 reaching the columella, most with fine paliform lobes. In other parts the calice is more pad-like at the edge, no visible theca, 1—3 mm. deep, often with additional, very small costae not represented by septa; latter thick and rough, less than 1 mm. exsert, 10—12 reaching columella with thick, blunt, paliform lobes, sometimes projecting above the level of the theca.

Locality. (1) Lagoon, flat behind Ragandi Islet, Minikoi; (2) lagoon shoal, Minikoi; (3) Hulule, west reef; (4) Goidu, sand-flat behind boulder zone. No. (3) is a separate, rounded colony, 13 cm. in diameter by 8 cm. high; the rest are larger blocks from the living edges of great massive colonies, most parts of which have for some cause or other been killed. **Colour,** light green over the theca, very dark orange-green on the peristome.

38. Orbicella borradailei, n. sp. (Pl. LXIII. fig. 34.)

Colony massive, rather irregular, covered under the edges by a distinct, transversely waved epitheca. *Corallites*, 11—15 mm. in diameter, edges raised into broad, padded rings 2—5 mm. high, somewhat crowded together and distorted, especially on the inequalities. *Calices* also distorted, 9—11 mm. in diameter, 3—6 mm. deep, no theca visible from surface

view, separating furrow naturally very marked. *Costae* low, thick and broad, alternately thicker and thinner, hence in two series, the thinner very commonly with no corresponding septa visible, all set on their edges with low, transversely extending granulations. *Septa*, 35—40 in number, alternately larger and smaller, yet both series varying somewhat in size, roughly granular at the sides, 1—2 mm. exsert, all rather thickened on passing into the theca, here and there septa of the second series curving towards and uniting with one of the first; edges sometimes no distinct teeth, sometimes about six low, rough ones, generally about 15 with prominent, broad (1 mm.), thicker, uprising paliform teeth forming a definite crown. *Columella*, 2—3 mm. below the paliform crown, $\frac{1}{4}$—$\frac{1}{3}$ of the calice in width, flat above, formed by rather coarse, flattened trabeculae from about half of the septa. *In section*, the theca of the calices very distinct, costae often continuous, exothecal dissepiments horizontal, thin, 1 mm. apart; endothecal dissepiments thin, about 1 mm. apart, almost horizontal, in transverse section not more than one visible between the theca and the columella. *Increase* generally by inter-calicinal budding, occasionally intra-calicinal close to the margin, very rarely fission.

The species is very distinct from all previously described. There can be no doubt about its being an Orbicella, but it closely resembles in its corallites some of the tubuliferous Favia. The fact that the costae are about twice as numerous as the septa (about 76 to 42 in large calices) is most characteristic, but in places near the edges the septa and costae often become quite thin, the smaller series of costae almost absent, paliform lobes little marked and corallites less projecting.

Locality. Breaker zone of reef-flat close to Ragandi Islet, Minikoi.

39. Orbicella ?curta Dana. *Zooph.* p. 209, x. 3, Gard., p. 754.

A small fragment from N. Mahlosmadulu, 4 *f.*, comes near this species, but the septa are rougher toothed and more equal.

40. Orbicella (Leptastraea) immersa Klz. Klz., p. 47, VI. 1.

A rounded mass, 7 cm. long, once completely covered by living polyps, now dead in places, certainly belongs to this species, though the calices are in parts slightly smaller with rougher septa.

Locality. From the passage at Hulule.

41. Orbicella (Leptastraea) ehrenbergana (Ed. and H.), Klz.

Ed. and H., II. p. 494, D. 7. 4, Klz., p. 46, VI. 3 and Leptastraea transversa Klz., p. 46, VI. 2, Orbicella klunzingeri Gard., p. 755.

Nineteen specimens, some of which agree absolutely with the one description of Klunzinger and some with the other, but most of which are intermediate in some of their characters. Ed. and H.'s description and figures differed so widely from Klz.'s that I did not consider that these authors were referring to the same species when I examined my collections from the Pacific. My present large series, together with my two Pacific Ocean specimens, shows the variation to be so great that there can be no doubt of the identity.

It appears to me useless to attempt to re-describe the species from any central form, especially as any large collection is likely to have forms almost exactly similar to Klz.'s ehrenbergana or the same author's transversa from precisely the same locality or even environment, certainly at any rate from the breaker zone or flat of any reef. Yet, in certain calices of these forms variations may be found connecting them together, though one part of

a colony does not apparently belong distinctly to one form and one to the other. We have here accordingly both classes of variation, (1) the *vegetative*, mainly seen in the thickness of the walls, sizes of calices, number and shape of septa and the size of the columella, and (2) the *normal*, seen in the shapes of corallites, characters of dividing furrows, depth of calices, nature of columella, besides in some of the characters of (1), indeed in most of those which caused Klunzinger to separate ehrenbergana and transversa. There is no trace of discontinuous variation in my specimens, though Klunzinger is probably dealing with it. In the remarks on the variation of the individual organs which I have to offer below, it is certain that I am dealing mainly with the normal, though it is clear that one cannot as yet, with a study of only 21 specimens, draw a line between the variations. Between each form of any organ mentioned I have found numerous intermediates.

The *colonies* are of two indistinctly divided types, (*a*) flattened incrusting, often rising up into rounded hillocks which tend to become loosened, and covered all over with the living tissues, and (*b*) massive, more rounded, frequently of considerable thickness and always very dense and heavy. Though there are marked exceptions (*a*) certainly approach closer in their other characters to Klunzinger's ehrenbergana and (*b*) to transversa. The *corallites* are quite rounded, or even angular or distorted, or crowding over one another; dividing furrows very narrow, not visible to the unaided eye or 1 mm. broad, depth ·1—1 mm., where very small a mere flat area between neighbouring calices. *Costae* never continuous between calices, often not visibly present. *Calices* varying in shape according to the corallites, theca visible or not, depth from 1 to 4 mm. *Septa* 24—44, mode about 28 or 30, not at all or very little exsert, generally thickened where they join the theca, quite smooth, thin, somewhat distant to very densely crowded, sometimes arched at their sides and upper ends, sometimes flattened above and falling perpendicularly; generally no determinable cycles, I. and II. occasionally distinct and then equal. *Columella* formed by trabeculae from 12—20 septa, one-fourth diameter of calice or scarcely visible, finely papillate or fasciculate above or merely a few twisted trabeculae. *Increase* by extra- or intracalicinal budding. Fission extremely rare. *In section* all more or less the same, little apparent variation.

Locality. The species is fairly common on the reef-flat near the breaker zone and on the Maldive lagoon reefs, but seldom forms very large masses. Loose heads are frequently found on the boulder zone, where there is little or no sand or in hollows between other corals. When split open, their centres usually consist of their own remains, a good deal broken down by boring animals, often with Lithodomus and Gastropods. Their surfaces are frequently broken by the shield-like ends of Pyrgoma and the smaller oval openings of another barnacle in the walls. Generally the extreme forms are less affected than the intermediates.

42. Orbicella (Leptastraea) bottai (Ed. and H.). (Pl. LXIII. fig. 36.)

Cor. II. p. 486. Klz., p. 44, v. 9 and x. 13 *a* and *b*. Leptastraea inequalis Klz., p. 45, v. 6.

I refer sixteen specimens to this species, with which Klunzinger's second species is undoubtedly synonymous. The specimens vary greatly in their different parts, and as compared with one another. The *colonies* are mostly rather flat and incrusting, but there is one large, round one, and one smaller and oval, almost completely covered with polyps. The *corallites* are round or compressed, and have their edges scarcely rising above the general level, or 1 mm. upstanding above the furrows, isolated ones rising to 2 or 3 mm., or on hillocks, etc.,

pressing over one another, to the last belonging the round form which in this respect is exactly as described by Klunzinger for L. inequalis. The *calices* of flat specimens and of the round one average 2·5 mm. in diameter, or somewhat more hilly 3·5 mm., the living edge of a once large mass 4 mm.; here and there a giant calice may be found, one rather rough specimen with low calices averaging 3 mm. having a number of these standing up for 2 or 3 mm. and being 4·5—6 mm. in diameter[1]. The *costae* may be distinct or not visible, distance between the calices ·5—2 mm. or more, especially on the under side. *Septa* rough or quite smooth, in giant calices 38—40 down to 20 in the smaller ones, very rough sided or almost smooth; in the round and most forms with larger calices, cycles I. and II. quite equal, or in many of the smaller caliced flat forms I. distinctly larger than II. *Columella* well developed or scarcely visible, in some cases in surface view clearly formed by trabeculae which end above in fine points, in others like the end of a bundle of thick rods, formed from 12 septa or more in the first case (round and most forms) and from 10, 8 or even 6 (one specimen) in the flat forms.

Locality. Common on the reef-flat at Minikoi and throughout the Maldives, rare on lagoon reefs. **Colour,** a dark but brilliant green.

XV. Genus *Cyphastraea.*

Cyphastraea and Solenastraea Ed. and H., Cyphastraea Klunzinger.

The growth of the genus is mainly incrusting, though it frequently attains a thickness of several inches to a foot. It closely follows any inequalities on its base of attachment, and tends, if it gets free, to round itself off and become completely covered with polyps. More massive growths on any colony may rise into hillocks, which themselves frequently become rounded off. The corallum below the living tissue forms a home for all sorts of boring animals, and tends to become much broken up and hollowed even to within 3 or 4 mm. of the living polyps.

Distribution. Occasionally found incrusting on the reef-flat, or breaker-zone, or on lagoon shoals; free masses in protected situations of the same, but never on sand. Depth, 0 to 40 *f.* **Colour,** grey-green.

43. Cyphastraea forskaelana (Ed. and H.). Ed. and H., II. p. 497.

Two colonies, both of which form masses much bored into and killed at the base, and covered with convexities and humps, not free. The *calices* (2 mm. in diameter) are thick edged and crowded together except underneath and near the edges of the colonies, rounded, not distorted, commonly projecting for at least 1 mm. *Exotheca* appearing vesicular from the surface, fairly dense in section, with a few, rough, pointed spinules, generally clearly connected with the costae, which are little prominent and very rough, varying up to 24 in number. *Septa* little exsert, sides covered with low, rough spinules, scarcely toothed, systems and cycles quite distinct, primaries much more prominent and rougher, running right into a well-developed, rather shallow, finely trabecular columella. Secondaries commonly much thinner, and occasionally simulating the primaries and fusing with the columella, especially near the edges, where the calices are more distant. Tertiaries very small.

[1] Cp. Prof. Bell's description of Variation in Turbinaria, *Quar. Jour. Micros. Soc.*, 1895, p. 148, pl. 1 and 2.

The species has a much rougher appearance than C. savignyi, from which it differs markedly in its septa. With Solenastraea forskaelana Ed. and H. the specimens agree in all respects except in the different sizes of their septal cycles, but this is a variable character.

Locality. Hulule, (1) W. reef, and (2) passage through same.

44. Cyphastraea savignyi (Ed. and H.).

Ed. and H., II. p. 485. Klz., p. 51, and Gard., p. 761.

Four specimens, all more or less rounded and completely covered by living polyps, of the identity of which with the above no doubt can be entertained. One specimen, a ball, completely corresponds to Klunzinger's description, differing somewhat from his figure, to which a second rather irregular specimen, evidently grown under bad conditions, completely answers. The other specimens have slightly larger corallites, in exsertness intermediate to my Rotuma specimen, but more crowded together. The costae are always very prominent and not rough. The exotheca has tiny, somewhat scattered spinules, but in the second specimen referred to appears from surface view to be vesicular. Twelve rather smooth septa typically fuse in the columella, and are equal sized. The theca of the calices is often very delicate, giving their edges a thin appearance.

Locality. Goidu, all from hollows of the reef-flat and boulder zone.

45. Cyphastraea hemprichana (Ed. and H.). Ed. and H., II. p. 495.

A single specimen, almost completely surrounded by the corallites, a free edge showing in one place covered by a dense epitheca. Calices on the upper surface crowded, about 1·5 mm. in diameter, half this breadth distant from one another underneath, edges always distinct, appearing more prominent owing to the slightly exsert upper ends of the septa. Exotheca with a few, almost smooth spinules above, lower and scarcely visible below, not clearly connected with the costae, which are quite distinct at the edges of the corallites. Septa relatively smooth and very little toothed, edges almost perpendicular, 6 clear systems and 3 cycles quite distinct from one another, primaries meeting in the centre of the calice so deep down as scarcely to be visible from the surface, shallower calices underneath.

Locality. Hulule, from the reef-flat of the south end.

46. Cyphastraea microphthalma (Esper). Ed. and H., II. p. 485.

I refer to this species three specimens, which agree with the descriptions in all essential characteristics. The *corallites* may be crowded or separated by half their diameter from one another on the outgrowing edges, slightly (·5 mm.) or not at all projecting, but always distinct owing to the arched, slightly exsert, upper ends of the septa. *Costae* sunk in the exotheca, edged with numerous, very rough, low spinules, giving a granular appearance. *Septa* similarly very rough, as described by Ed. and H. Paliform teeth present or absent. *Columella* always distinct, ending in papillae, or of a trabecular appearance. *Exotheca* very dense, in places almost solid, with here and there relatively large cavities.

Locality. (1) Turadu, S. Mahlosmadulu, W. reef, near breaker-zone, a rather smooth incrusting mass, much studded with Pyrgoma up to the pores of which the corallum extends; (2) S. Male, 25 *f.*; (3) Suvadiva, 31 *f.*, and (4) Addu, 40 *f.* on the outer slope, both the latter rough with trabecular columella and very indistinct paliform lobes.

47. Cyphastraea suvadivae, n. sp.

Colony flat, incrusting, but probably showing all the regular shapes found in other species of the genus, covered with round, scarcely projecting *corallites*. The latter 1—1·5 mm. broad, from 1·5—3 mm. distant from one another, joined by a vesicular exotheca covered with small, low, blunt spinules, which near the calices may be arranged in lines leading to the low spines, which represent the costal plates. *Theca* scarcely raised above the exotheca around the edge of the calice, the ring-form being mainly due to the slightly exsert, upper edges of the *septa*. Latter numbering 24, those of cycle III. very thin but generally distinct, projecting half-way to the columella; those of cycles I. and II. nearly equal, with rough, spiny sides, giving them a coarse appearance, edges bluntly notched, the inner teeth not distinguishable from the two or three rough rods of the columella. Calices quite shallow, with a closed in appearance below. The *exotheca* is formed by minute cell-like vesicles. In some sections it almost simulates the appearance found in Galaxea, but is clearly dependent on the costae. The endothecal dissepiments are very thin, close together and almost horizontal.

The species approaches nearest to C. microphthalma, but differs in its more distant calicles and much lighter and more open method of growth.

Locality. Six small pieces from Suvadiva, 20 *f.* They are somewhat distorted on the surface with barnacles and worm tubes, and the structure underneath more or less destroyed to within 4 mm. of the surface by boring animals.

48. Cyphastraea maldivensis, n. sp.

Colony consisting of thin, incrusting masses, but probably showing all the shapes found in the genus. *Corallites* round, practically not projecting, not more than 1·5 mm. broad, generally separated by at least two or three times their diameter from one another, joined by a glabrous looking exotheca, obviously even from the surface formed by very small, flattened vesicles, often with their walls incomplete on the surface, but where complete studded with low rounded granules. *Costae* practically non-existent, but tops of the septa a little projecting over the upper ends of the calices, giving an appearance of rings slightly raised round their edges. *Septa* 24, tertiaries distinct at edge of calice, projecting about one quarter way to columella, ending perpendicularly inside with small, pointed teeth; primaries and secondaries nearly equal, rather thin, slightly exsert, a few spines on the sides, ending inside with long, thick, pointed, spiny teeth, extending almost at right angles over the axial fossa, the inner parts of the septa by their fusion presenting sometimes a fenestrated appearance. *Columella* formed by open trabeculae from the septal edges, a quarter to a third the width of the calice, sometimes with points above but never papillary. The calices, owing to the small breadth of the tertiary septa, the thin septa and large columella, appear relatively open.

The exotheca is more abundant and vesicular than it is in the last species, and still more closely resembles Galaxea; the piling up of the vesicles on the surface between the corallites is very distinct. The species more closely resembles the last than any other, but differs in its surface appearance, thinner septa with long pointed teeth and trabecular columella.

Locality. S. Nilandu, 25 *f.*, and Felidu, 20 to 25 *f.*

Characters	*Echinopora rosularia* (Lmk.)	*Echinopora solidior* (Ed. & H.)	*Echinopora tertia*, n. sp.
1. Size of Calices.	3 × 4 mm. or round.	6 × 5 mm. or round.	5—7 mm. × same.
2. Depth of Calices.	1 mm.	2 mm.	1·5 mm.
3. Edges of Calices.	Little cones, 1—3 mm. high. Septal spines thin, 1 mm. high.	Flat. Thick spines from about 15 septa, 2 mm. high, subequal.	Flat. Septa not more than 1 mm. exsert, thin.
4. Costae.	Very close set, fine lines, made up of fine, low (·5 mm.), rounded spinules.	Edge of colony lines of flattened rough spinules, 1 mm. high; central part irregular.	At edge lines centre irregular; vary from round, smooth to characters of last, always thinner, ·75 mm. high.
5. Number of Septa.	16—24	24—30	36—48
6. Character of Septa.	I and II cycles subequal, rough and thick at edge of calice with 3 blunt, rough teeth, 2 on exsert upper edges, the 3rd and innermost, only present on about half, quite paliform; III very minute and thin.	About 18, larger, rough, thick at edge of calice, no distinct teeth, rather more than half with a small thick paliform tooth. Between last about 10 very minute septa.	Typically I and II larger and subequal, rough, uppermost tooth over theca longest, lowest where present very fine and subpaliform, III similar but thinner; IV minute, commonly bend round and fuse with III at middle of their breadth.
7. Columella.	About $\frac{1}{4}$ breadth of calice, spongy, dense, very fine trabeculae from about 10 septa.	Similar to last, but much less dense and from about 18 septa.	Similar to last, rather hollowed in centre from about 14 septa.
8. Section *a*. Exotheca.	Scarcely visible, very dense.	Dense, vesicular.	Very dense, vesicular.
b. Endotheca.	Not clear, horizontal (?).	Horizontal, 5 mm. apart, thin.	Irregular, little vesicular, dense.
c. Septa.	Fenestrated; especially line outside pali lobes which are hence true pali.	As last.	Perforated at edges; no true pali.
9. Growth characters and epitheca.	14 specimens, largest a foliated cup 13 × 18 × 9 cm. deep, ·5 cm. thick, most merely folia, one incrusting 3·5 cm. thick. Epitheca 2·5 cm. from edge which is evenly costulated, smooth or minute spines.	A single folium 7 × 10 cms. by 18 mm. thick in centre. Epitheca to 5 mm. of edge, otherwise same as last.	Two thick masses, largest 10 × 14 cm. by 4 cm. thick, incrusting thin at edges. Epitheca, etc. same as last.
10. Locality.	Common, W. Reef, Hulule, foliated masses 2 feet or more across, and a small piece from Felidu, 14 *f*.	Passage into Hulule.	Edge of S.W. Reef, Hulule.
11. Colour.	Green.	Brown.	Green-brown.

Comparison and Characters of Echinopora rosularia, solidior and tertia (see p. 782).

XVI. Genus *Echinopora*.

Dana, p. 278. Ed. and H., II. p. 621. Klz., p. 54.

A genus closely allied to Trachypora (syn. Echinophyllia), which has been generally confused with it. No specimens come from Minikoi. E. rosularia is alone abundant, but it is very local and scarcely a reef-builder.

49. Echinopora rosularia (Lmk.). (Pl. LXIII. fig. 37.) Ed. and H., II. p. 623.

50. Echinopora solidior (Ed. and H.). (Pl. LXIII. fig. 38.) Ed. and H., II. p. 626.

51. Echinopora tertia, n. sp. (Pl. LXIII. fig. 39.)

The three above-mentioned species are evidently so closely allied that it seems most useful to represent their characters in tabular form (p. 781). They are from the same locality and also environment, but I cannot see that they show any signs of merging into one another. One is naturally inclined to suspect a relationship to Klunzinger's 3 species from the Red Sea E. ehrenbergi, concamerata and carduus, but, if the characters of these forms be tabulated and compared with the above, the whole six would appear to be different.

Doubtless all the three forms grow into the same shape under favourable conditions, incrusting base rising into flat or rounded folia, on one side covered with polyps, but occasionally folia fusing so that both sides may appear to be so. The calices on the folia often have their lower edges higher, where also the costae are more marked and longer spined than on the incrusting base; otherwise variation is very slight and mostly vegetative. Increase takes place as in other Echinopora.

52. Echinopora magna, n. sp. (Pl. LX. fig. 10.)

Colony foliate, epitheca thin, underside covered with rounded, radiating ridges, 8 in 1 cm. *Calices* round, 7—9 mm. in diameter, lower sides much raised on folia so that the whole opens upwards. *Costae* large and very thick alternating with much smaller and finer; the larger with a few broad, blunt, low spines, at the lower edge of the calices much thicker and with two or three blunt spines or lobes, 2—3 mm. long. *Septa* very thick, especially at lower edges of calices, thin inside, about 12 subequal with often near their lower ends two or three pointed teeth alternating with very small ones, corresponding to the smaller series of costae. *Columella* about $\frac{1}{4}$ breadth of calice, rising little below level of theca, appearing finely paliform, really somewhat spongy and formed of trabeculae from half of the septa. In *section* exo- and endothecal dissepiments more or less horizontal, thick or thin, somewhat vesicular, 1—2 mm. apart.

The specimen is merely part of the foliated edge of a much larger colony. It appears to be a true Echinopora, approaching the so-called E. aspera which is, according to Klunzinger, a Trachypora (Fungidae).

Locality. S. Nilandu, 30 *f.*

XVII. Genus *Galaxea*.

The genus is mainly interesting from the fact that of the fourteen specimens obtained nine were dredged from various depths down to 36 *f.*, outer slope and lagoon. Among Maldivan reef forms the genus is rare.

53. Galaxea fascicularis (Linn.).

G. fascicularis et irregularis Ed. and H., II. pp. 227 and 229; Klz., p. 78.

I refer eight specimens to this species from which I am unable to separate G. irregularis, since they all show variations intermediate to the previously given characters of the two species. The variation is well dealt with by Klunzinger for G. irregularis. One specimen in places recalls G. musicalis, but elsewhere clearly belongs to facies irregularis.

Locality. Reef-flat, Addu and Turadu, S. Mahlosmadulu; west reef, Hulule; velu, Hulule, 6 *f.*; N. Male, 18 *f.* and 21 *f.*; Suvadiva, 20 *f.*

54. Galaxea musicalis (Linn.). Ed. and H., II. p. 225.

I cannot define any specific characters beyond those given by Ed. and H. The larger septa are 1—1·5 mm. exsert, all are represented by costae, and all three cycles are generally clearly visible; those of cycle I. are larger than II., but both I. and II. fuse by trabeculae in the axial fossa.

Locality. N. Male, 25 *f.*; S. Male, 26 *f.*, and Addu, outer slope, 25 *f.*

55. Galaxea hexagonalis, Ed. and H. Ed. and H., II. p. 226.

A very much more delicate coral than G. fascicularis with septa 2—3 mm. exsert, much more marked costae and a well-developed columella, formed of coarse trabeculae, quite distinct even in the smallest corallites, besides all the other characters given by Ed. and H. The perithecal vesicles are thinner walled and appear rather larger than in G. fascicularis.

Locality. Inner part of reef-flat of Minikoi and N. Male, 25 *f.*, a few corallites. **Colour,** transparent, hence appearing white, with peristome dark olive.

56. Galaxea lamarcki, Ed. and H. Ed. and H., II. p. 225.

Milne-Edwards published excellent figures of this species (*Le Règne Animal de Cuvier, Atlas*, pl. 85, figs. 1, 1*a*—*b*) from which my specimen differs in having the corallites averaging 2—2·5 mm. in diameter, the primary septa ·5—1 mm. exsert, in most calices 6 septa as in fig. 1 fusing to form the columella, though certain rather larger and more upstanding calices exactly resemble fig. 1 *a*, perithecal cells quite distinct on the surface, continuous throughout and not in bands. The separate vesicles are larger than in any of the other species in the collection, and the corallum is extremely light. Its under surface is covered by a distinct epitheca.

Locality. S. Nilandu, 36 *f.*

57. Galaxea, sp.?

A fragment with 20 corallites with perithecal vesicles very similar to the last but smaller, corallites slightly larger and rising for less than 1 mm. above the peritheca, septa scarcely exsert, fusion of primaries only in the axial fossa, septal cycle III. scarcely represented, corallites 6—9 mm. distant.

Locality. Felidu, 25 *f.*

XVIII. Genus *Stephanocoenia.*

58. Stephanocoenia maldivensis, n. sp. (Pl. LXII. figs. 29 and 30.)

Colony at first incrusting, then massive, covered up to the edge with a distinct epitheca. *Calices*, polygonal, often somewhat elongated or distorted, 4—6 mm. in diameter, 2—4 mm. deep. *Walls*, ·5—2 mm. thick, pointed or not, covered by the exsert (·1—1 mm.) rather angular or slightly flattened ends of the septa, which may be continuous between the calices or alternating. *Septa*, two series, 6—12 larger, subequal, scarcely toothed save for a crown of low, rather pointed perpendicularly rising teeth against the axial fossa, and 6—12 very minute, more or less alternating with the larger. *Columella*, a single fine, possibly somewhat bent rod, occasionally branched once or twice, joined here and there by trabeculae to the septa. In *section* walls solid or with a line of small vesicules in the centre; endothecal dissepiments ·5 mm. apart, thin, rather irregular, almost horizontal, occasionally joined forming vesicles; columella continuous from base; septa fenestrated, especially in a line behind their thickened edges, which probably represent true pali. *Increase* by marginal budding.

Locality and variation. (1) The greater part of a colony 14 × 8 cm. by 6 cm. thick from outer edge to the fissure zone of Minikoi reef; colour, living, olive-brown; a heavy rounded colony, walls 1—1·5 mm. thick, calices 4—4·5 mm. deep, 4·5 mm. in diameter, budding vigorous. (2) Five pieces, all from Hulule, the largest an edge of an incrusting mass 12 × 9 × 3 cm. from the S.-W. reef; light, often very thin walls, rather irregular on surfaces, calices smaller in hollows, generally about 4 mm. in diameter, rather shallow loculi, septa often only 6—9 of the paliform series. (3) Four fragments from fissure zone of W. reef of Maradu, Addu; heavy, rather approaching (1) but calices 5—5·5 mm. in diameter, not more than 3 mm. deep and columella tending to become compound. (4) A small colony from the passage into Hulule; large, elongated (5·5 mm.) calices, top endothecal dissepiments rising to within 1 mm. of edges of septa and obliterating the columella.

XIX. Genus *Acanthastraea.*

59. Acanthastraea hirsuta, Ed. and H. Ed. and H., II. p. 502, D. 5, 4.

Var. microstoma, Klz. (Pl. LIX. fig. 6.) Klz., p. 42, V. 2.

Var. megalostoma, Klz. Klz., p. 42, V. 1.

In section my specimens have solid thick walls, 2—3 mm. thick, and dissepiments thin, rather oblique, tending to be vesicular, 1·5—2 mm. apart. I can see no true columella, but the section shows a mass of relatively large, blunt, obliquely upstanding teeth from about a third of the septa, filling up the axial space. My specimens in every part so distinctly belong to one or other of the two forms as to suggest that Klunzinger is here dealing with true varieties and not merely *facies.*

Locality. Minikoi, reef-flat (var. microstoma) and Hulule passage (var. megalostoma), rare, only two specimens.

XX. Genus *Prionastraea.*

The genus is in its definition a most unsatisfactory one. It shows many resemblances to Goniastraea, from which, owing to budding sometimes taking place close to the columella, individual specimens can only be separated with difficulty. It assumes, indeed, the same position in respect to it as Orbicella does to Astraea.

The species in the collection shows very distinct variation, which is mentioned under each. In all characters it seems to be very largely correlated with environment, *i.e.* vegetative. The edges, the upper sides and lower parts perhaps of the several species, differ somewhat from one another in the sizes, depth, thickness of walls, spinulation, etc. of the calices. Yet the colonies of P. crassior and P. fusco-viridis clearly show that there are limits to this variation, and that it follows along distinct lines for the several species. The two types of calices described in P. robusta and P. magnistellata are also in this respect remarkable. The number of the septa is fairly variable for each species, but the number which run into the columella is about the same in all (18—24) owing to physical causes. The septa preserve their type in each species, though this shows considerable variation in P. fusco-viridis, apparently in this case largely connected with the several localities from which the specimens were obtained.

Distribution. A common reef-builder, great masses on the outer slope to 15 *f.*, small colonies on the reef-flat even under the breakers, very common on lagoon shoals, often forming overhanging masses; vertical to 30 fathoms. **Colour,** generally brown to green. The colonies tend to be much bored into by worms and other destructive organisms at the base, but the surface is usually entire.

60. Prionastraea pentagona Klz. Klz., p. 39, IV. 7, and X. 5.

A small specimen, 8 × 6 cm., from the breaker zone of the reef at Minikoi, closely resembles Klunzinger's description and figures of this species. The calices are rather smaller, averaging about 6·5 × 5 mm., largest 8·5 × 5 mm.

61. Prionastraea spinosa Klz. Klz., p. 39.

A small specimen from S. Nilandu, 30 *f.*, with a dozen corallites answering in every respect to the above species save that it would appear to be in its structure rather more delicate. The septal sides are a little rough and spiny.

62. Prionastraea robusta (Dana). (Pl. LXIV. fig. 42.) Dana, p. 248, XIII. 10.

A specimen similar to P. crassior in shape, with similar rough-sided septa with blunt, spiny teeth (a little higher and more regular than Dana's fig. 10 *b*), with nearly solid walls, endothecal dissepiments about ·5 mm. apart (in longitudinal section 3 cells in 2 mm.), not very oblique. The *columella* is one-fourth to one-fifth the diameter of the calice, almost flat-topped, dense, very finely trabeculate, spongy, and the innermost teeth of the septa, especially in the deeper calices, simulate a paliform crown.

The specimen is part of a mass, one side and much of the top of which had been killed apparently by sediment, while the other side was growing out vigorously underneath, with a longitudinally striped, almost costate, lower surface, with no distinct epitheca such as is generally found in the genus. Budding takes place near the centre of the calice so as almost to simulate fission, a character considerably enhanced by the rapid formation of

the dividing walls. All the calices are polygonal with thin edges but may be divided into two classes, (*a*) those on the top scarcely showing any budding, 10—14 mm. in diameter, walls thin edged but 1—3 mm. thick at level of columella, septa about 34, alternately larger and smaller, more than two-thirds reaching the columella, each with 6—10 low, subequal, blunt, rough teeth, the innermost commonly larger and forming a little crown rising 1·5—2 mm. above the top of the columella, and (*b*) those to the sides, vigorously budding, 6—9 mm. in diameter, crowded, more irregular, less polygonal, walls thin, at level of columella not more than 1 mm., same depth or even up to 5 mm. (hence appearing very markedly different), septa about the same number alternately larger and smaller, less than two-thirds reaching the columella, with 2—7 (commonly 3 or 4) much higher, irregular, very blunt and spiny teeth, those round the pali narrower but not more marked than the rest, though rising to the same height above the columella.

This extraordinary variation of the calices represents types as distinct as P. abdita and profundicella, or P. sulfurea and quoyi (see Ed. and H.), and throws a considerable light on the variability of the genus. It distinctly suggests that mere size has nothing to do with the number of septa in adult calices.

Locality. Hulule, reef-flat to south-west.

63. Prionastraea crassior (Ed. and H.). (Pl. LXIV. figs. 45, 46.) Ed. and H., II. p. 515.

I refer a specimen about 38 cm. long by 20 cm. high and the same in thickness, and probably having more than 2000 corallites, to this species, with the description of which it corresponds in every particular.

The *colony* is a very large, heavy mass, rough and uneven (hilly) on the surface but not in any way gibbous. It is covered with *calices*, the older of which average between 10 and 11 mm. in diameter, with younger ones of 5—7 mm. between. On the upper part the calices are more or less polygonal, relatively deep (5—6 mm.), thin walled (seldom less than 1 mm. except where a new calice has formed), but on the sides are more rounded or oval, shallower, and much thicker walled (2—3 mm.). The *septa* are continuous over the walls (1 mm. exsert), always slightly thickened, but quite markedly so towards the base of the mass, where, on the top of the walls, they alternate with fine ridges, not generally represented by any trace of septa within the corallites, and rise somewhat at the edges of the calices giving an appearance almost of furrowed walls. The septa number about 25—30 in the fully formed calices, approximately equal in size, no cycles distinguishable, often one or two groups of three fusing together, 20—24 joining in to the *columella* which is formed of fine trabeculae from their edges, closely packed together (spongy) in a mass about 1·5 mm. in diameter. The septa are narrow above and fall almost perpendicularly at the edges of the calices; they are thin and not granulated laterally, and their teeth are relatively low and blunt but increase in size towards the centre, the ring of teeth on the separate septa of the shallower calices simulating a crown of pali. *In section* the endothecal dissepiments are a little inclined, about ·8 mm. apart. The walls of the separate corallites are to a considerable extent welded together, but are more rapidly than other parts penetrated by boring organisms, so that they may appear relatively cavernous.

The colony was attached to the overhanging edge of a lagoon shoal by a narrow, dead base, on which part were growing Lithothamnion, Halimeda, red Polytrema, a colonial

Tunicate, Polyzoa, sponges, as well as a Madrepora, a Montipora and two Paracyathus. The coral itself is much bored into by worm tubes and apparently Achyla. Its edges are explanate, covered below by a dense wavy epitheca, the colony evidently attempting to grow out at the base in competition with the various organisms there settled.

Locality. Minikoi. The brownish-green colonies are fairly common on the lagoon shoals, though I only brought home a single specimen, not at the time recognising its specific identity from other species.

64. Prionastraea fusco-viridis (Q. and G.). (Pl. LXIV. figs. 43, 44.)

Quoy and Gaimard, *Voy. de l'Astrol.* IV. Pl. XVII. fig. 8. Dana, p. 229, Pl. XI. fig. 7. Gard., p. 759, Pl. XLVII. fig. 5.

I refer twenty-nine specimens, more than half of which are of relatively large size, to this species. In shape the masses vary from convex, with low elevations due to the surface on which they are seated, to flat or convex with upstanding, almost perpendicularly rising hillocks, sometimes flat with a corallite on the top, but more often ending in a thick ridge, all with calices on the sides.

The *calices* are generally polygonal in shape, about 11 mm. in diameter, but where about to bud may be narrow, up to about 20 mm. long, and in the valleys very small, 8 mm. or less in diameter; in depth they vary greatly, typically perhaps about 8 mm., shallower on the walls and near the edges. Their *walls* in the valleys of the colony are generally sharp pointed or ridged above, thicker below, 1 mm. or less, rising over the general surface to about 2 mm., and at the edges, or on elevations, or ridges to 3—4 mm. The *septa* are generally continuous between the calices, their exsert portions similar in every respect, not rising more than ·5 mm. over the walls, arched, giving the thicker an appearance of rounded off ridges. They vary in the average sized calices from 35—55 in number, but in the more elongate rise to 75 or more. No systems are distinguishable, the smaller occasionally fuse with the larger, and about 18 or 20 run into a spongy *columella* of 2—2·5 mm. in diameter, generally formed of very small, densely packed trabeculae from the septal edges. The sides of the septa may be almost smooth or spiny. The septal teeth are always bluntly pointed and low near the walls, generally 8—11 in number; they may be subequal, very little longer at the inner ends of the septa, or may become relatively long (2 mm.) and more pointed. The innermost may rise perpendicularly for 2—2·5 mm. above the columella, simulating a crown of pali but more commonly such is absent, the septal edges appearing almost to merge into the columella.

The edge of the colony, wherever visible, is covered with a thick, transversely wrinkled epitheca. The walls are exceedingly dense, in *section* often quite solid, sometimes with a line of cells in their centres. The endothecal dissepiments are thin, oblique (45° to the walls) ·5—1·5 mm. apart. *Increase* is by intercalicinal budding near the edges of the calices, but fission not infrequently occurs, especially in the valleys.

Locality. Very common on lagoon shoals and outer slope, often forming immense masses, both at Minikoi and in the Maldives, and one piece from N. Mahlosmadulu, 24 *f.* **Colour,** transparent or brown to dark green over the walls, brown-green peristome, edge of stomodoeum brilliant green.

The specimens vary considerably in their septal sides and teeth and the nature of their columella, *i.e.* (1) an incrusting mass without hillocks, septa smooth sides, low teeth, and columella typical; (2) numerous low hillocks, septa rough sides, teeth low, columella rising into points; (3) almost flat, few hillocks, septa nearly smooth sides, long teeth may simulate a pali crown, columella with points; (4) almost same as (1) with a few hillocks, septa tending to be alternately larger and smaller; (5) Goidu, very hillocky and ridged, septal sides smooth or low spinules, medium teeth, septa merging into a dense or slightly spiny columella; (6) Hulule, rounded or hummocky, septal sides smooth or very low spines, teeth longer than in (5), columella dense or almost appearing as if formed by the inner septal teeth; (7) rounded, septa thin sides, smooth, teeth long, distinct crown round columella; (8) rounded, sides of septa smooth, teeth very long and numerous, merging below into the papillated columella.

The species may be identical with P. obtusata Ed. and H., over which it has priority. It is considerably denser, heavier and shallower than P. abdita Ed. and H., which scarcely can be the same species described by Ell. and Sol. Of Klunzinger's species it differs from P. tesserifera in the character of its walls and septa, from P. vasta in the same and paliform crown, from P. spinosa in its very spiny septa and their number, while the size of the calices at once separates P. pentagona. P. gibbosa Klz. resembles it greatly, and indeed may well be a dwarf form with fewer septa.

65. Prionastraea magnistellata (Ed. and H.). (Pl. LXIV. figs 40, 41.) Ed. and H., II. p. 516.

Two specimens agree with the above-cited species in form of growth, size, shape and depth of calices, number and characters of septa, though there are two distinct sets, and in the distances between the endothecal dissepiments. The *columella* is not "bien développée, d'un tissu assez dense," but of rather coarse trabeculae, a character which in P. fusco-viridis may be seen to vary very considerably, and the *calices* are often relatively thick walled, and elongated or irregular in shape, largely owing to budding taking place near the inner ends of the septa.

The larger calices in my specimens range up to 23 mm. in length by 13 in breadth, but the average are about 17 by 14 mm.; in depth they vary up to 14 mm., averaging 11—12 mm., only edge or young ones less than 10 mm. The septa vary in number, in the largest calices 60—70, average sized ones 40—50, and occasionally fuse with one another; the systems are irregular and not distinguishable, 16—24 larger meeting in the central part of the calice. The dividing walls vary from 1—2·5 mm. in thickness; over them the septa are slightly thickened, about 1 mm. exsert, flat, finely toothed edges, over the thickened walls tending to have distinct notches or to be broken in the centre, almost giving the appearance of a furrow. The septal sides are slightly granulated, and their edges, falling at first almost perpendicularly into the calices, end in pointed teeth, which near the centre, where they are very crowded, increase in length up to 3 mm. The columella typically consists of a mass of rather coarse, twisted trabeculae from the septal edges 2—3 mm. across.

The specimens, two in number, differ considerably, though certain calices in each are not distinguishable. The Minikoi one is a convex mass 13 × 11 cm. with generally thick walls (2 mm.), septa about 55 in number, exsert portions of same notched, calices relatively larger and distinct columella, while the Hulule one is the edge of a mass killed in the centre, with quite thin walls over which the septa (about 42 in number) are very distinctly

thickened, calices narrower and hence appearing deeper, septal teeth not so markedly increasing in size towards the axial fossa, sometimes meeting over, sometimes merging into the smaller and less distinct columella.

Locality. Minikoi and Hulule, E. and W. reefs.

66. Prionastraea suvadivae, n. sp.

A rounded head, 9 cm. across × 6 cm. high, stalk covered by organisms, the greater part dead but calices quite distinct and 18 still alive when obtained.

Corallites varying up to 28 mm. long but the actual cavities much less, the calices not, indeed, averaging more than 15 mm. broad, 8—10 mm. deep. Dividing *walls* appearing from the surface a little hollowed out and exceedingly thick, 2—10 mm., but the greater thickness is made up of endothecal vesicles and very oblique dissepiments, reaching to within ·5 mm. of the granulated tops of the septa which are continuous between the calices. *Septa* numbering 30—40, smooth sided, set with 8—12 blunt, low, subequal teeth which on about 18 of the larger, merge into the trabeculae of the rather small, coarse columella. *Endothecal dissepiments* about 1 mm. apart, exceedingly oblique. Only one *bud* showing and that from about half way down the septa.

It is obvious that the circumstances controlling the growth of this specimen were eminently unfavourable—it was probably growing on the edge of a lagoon shoal and fell off into deeper water, the muddy bottom of which was slowly killing it—its very thick walls being a character associated generally with the edges or less vigorously growing parts of colonies. Yet it exhibits this last character to a degree more extreme than described in any other species. Its nearest ally is, in my opinion, P. favosa, but it is a distinct species. I give it a geographical name, as I am uncertain as to which of its characters are really of specific importance, although certain suggest other and more appropriate names.

Locality. Suvadiva, 25 *f.*

Genus *Merulina.*

67. Merulina ampliata Ell. and Sol. (Pl. LXIV. figs. 47, 48.)

Ell. and Sol., *Zooph.* p. 157, Pl. XLI. figs. 1 and 2; Esper, *Pflanz.* t. I. p. 96, Pl. LXXVII.; Dana, p. 272, xv. 2; Ed. and H., II. p. 628.

A single large specimen and several small pieces, all from the W. Reef of Hulule, which agree in every respect with the above descriptions. Off the outer slope at Goidu this or a similar species is very abundant forming foliaceous colonies two or three yards across and high.

68. Merulina prolifera Quelch.

Quelch, *Challenger Report on Reef Corals*, p. 110, Pl. II. fig. 1.

Three small specimens from Suvadiva 35 *f.*, S. Nilandu 36 *f.*, and N. Male 24 *f.*, appear to belong to this species, the type of which I have examined.

EXPLANATION OF PLATES.

(*All the photographs show the natural sizes of the different coralla.*)

PLATE LIX.

Figs. 1—3. Symphyllia sinuosa.
Figs. 4, 5. Antillia constricta.
Fig. 6. Acanthastraea hirsuta.

PLATE LX.

Figs. 7, 8. Coeloria magna.
Fig. 9. „ cooperi.
Fig. 10. Echinopora magna.
Fig. 11. Hydnophora grandis.
Fig. 12. „ maldivensis.

PLATE LXI.

Fig. 13. Favia cavernosa.
Figs. 14—18. Favia denticulata.
Figs. 19—21. „ hululensis.

PLATE LXII.

Fig. 22. Favia affinis (Minikoi).
Fig. 23. „ „ (Hulule).
Fig. 24. „ laccadivica.
Fig. 25. „ parvimurata.
Fig. 26. „ adduensis.
Fig. 27. Favia hombroni.
Fig. 28. Goniastraea solida.
Figs. 29, 30. Stephanocoenia maldivensis.

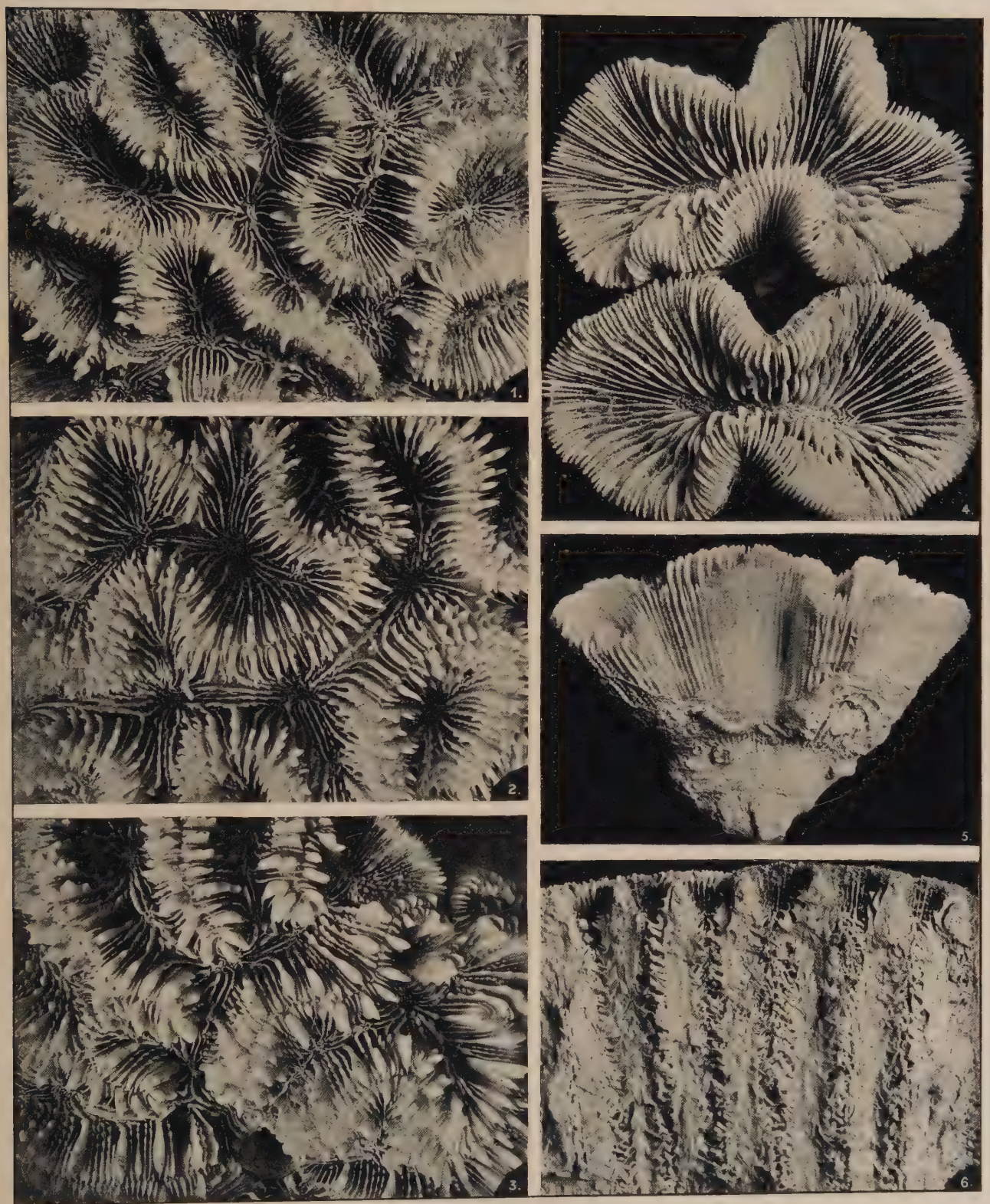
PLATE LXIII.

Fig. 31. Aphrastraea deformis.
Fig. 32. Orbicella annuligera.
Fig. 33. „ laxa.
Fig. 34. „ borradailei.
Fig. 35. „ minikoiensis.
Fig. 36. „ bottai.
Fig. 37. Echinopora rosularia.
Fig. 38. „ solidior.
Fig. 39. „ tertia.

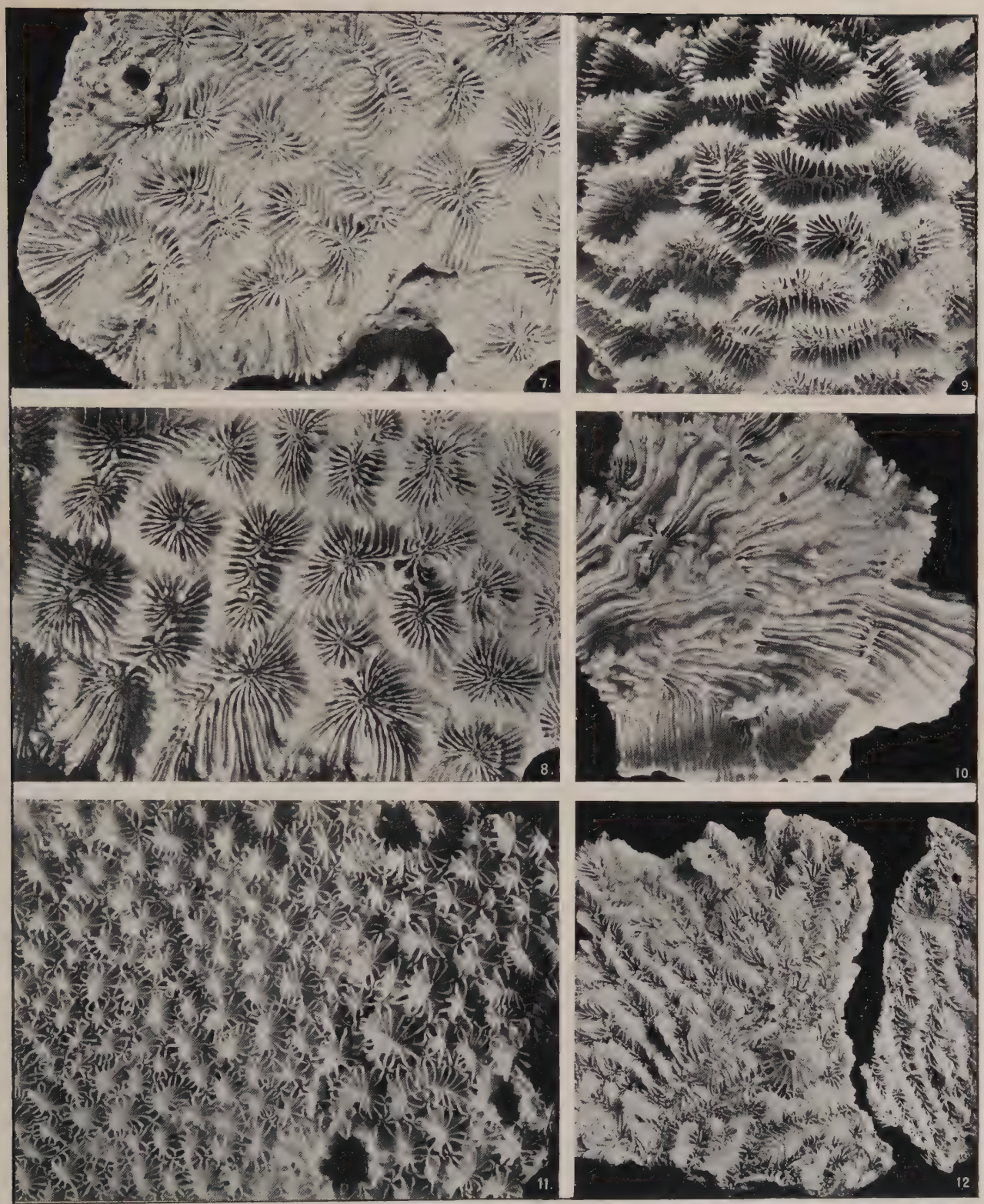
PLATE LXIV.

Figs. 40, 41. Prionastraea magnistellata.
Fig. 42. Prionastraea robusta.
Figs. 43, 44. „ fuscoviridis.
Figs. 45, 46. „ crassior.
Fig. 47. Merulina ampliata.
Fig. 48. „ „ (from beneath).

[I hope in a subsequent Part to publish figures of the two new species of Cyphastraea, the previously known species of which scarcely require further illustration. J. S. G.]



STANLEY GARDINER——ASTRAEIDAE (I).



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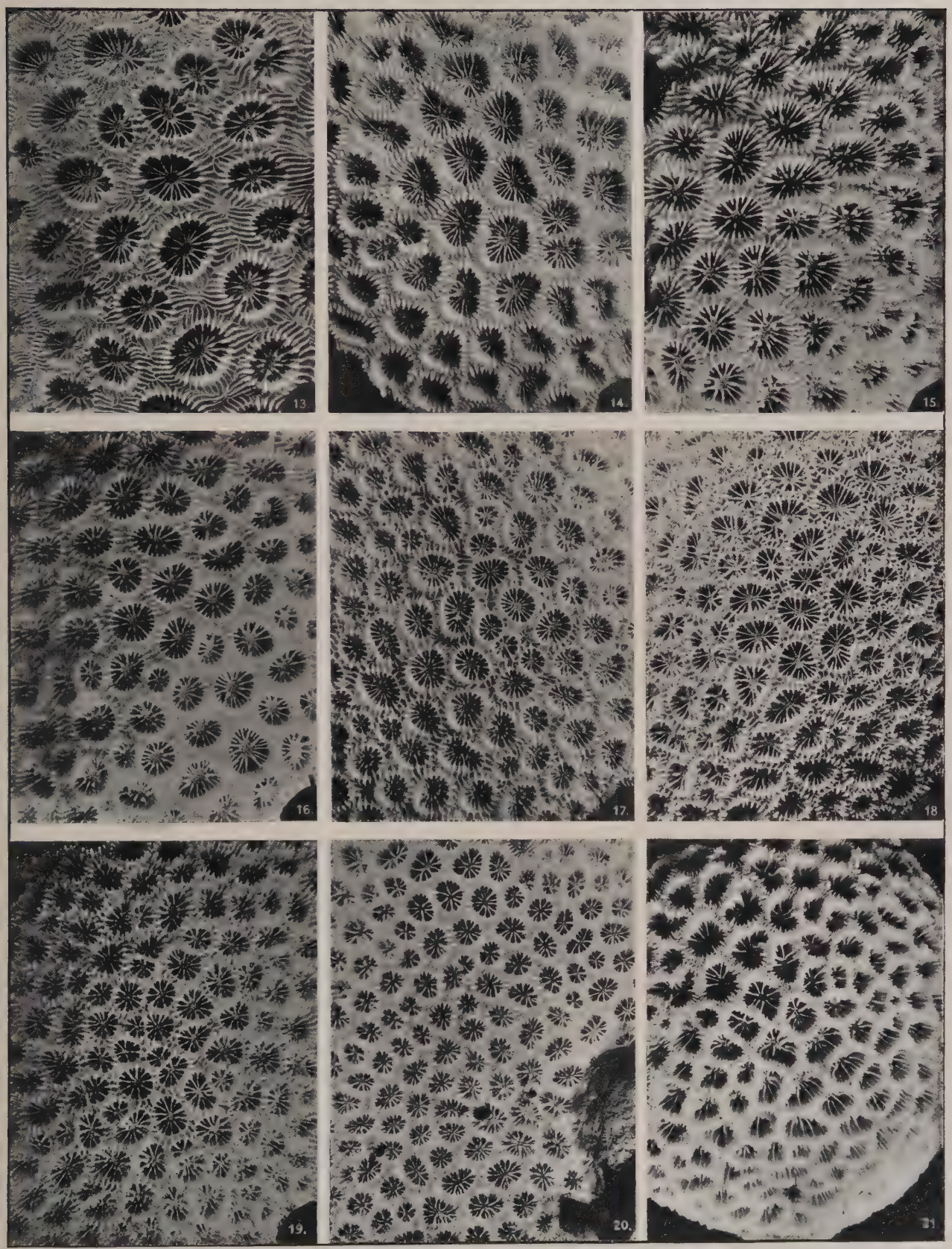

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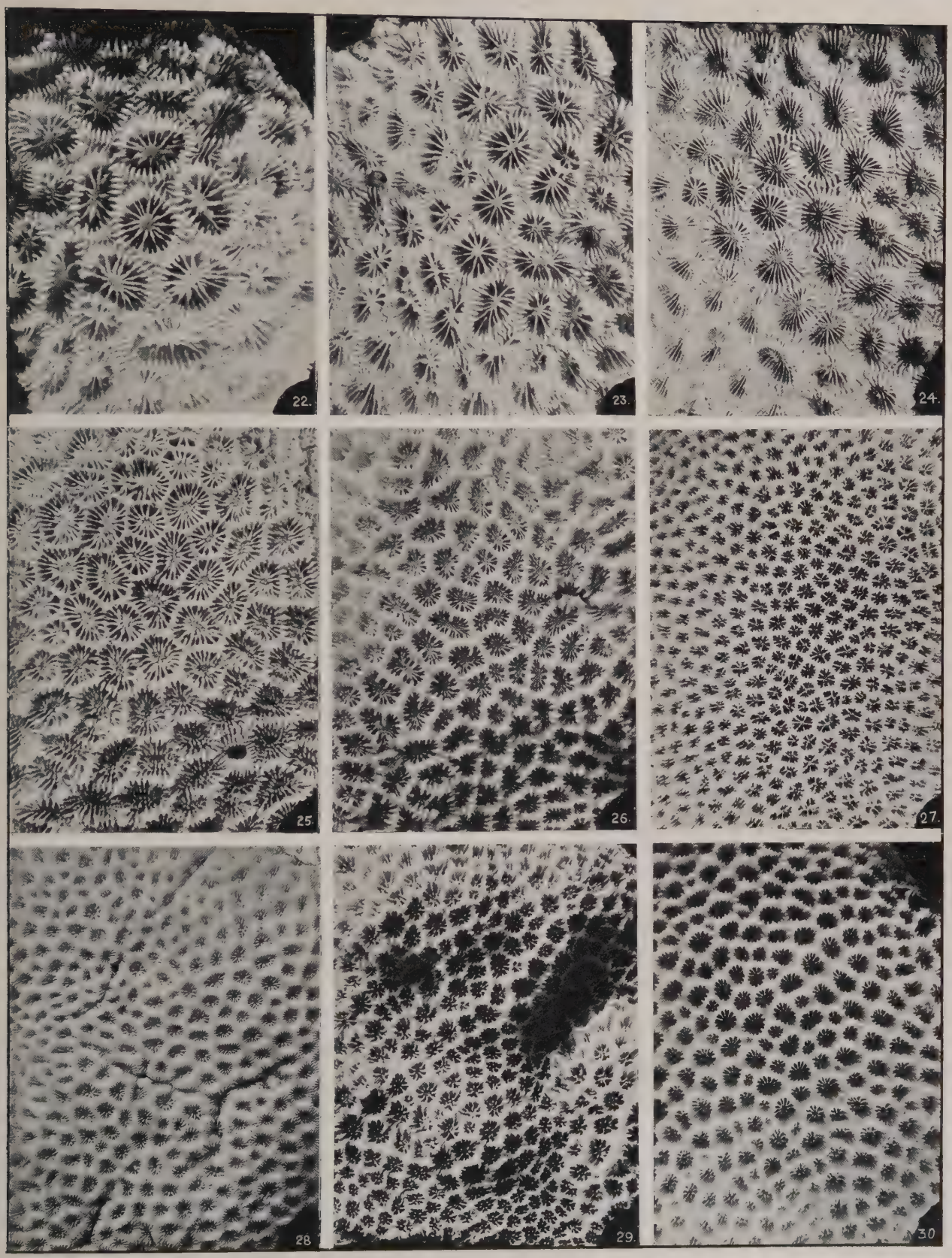

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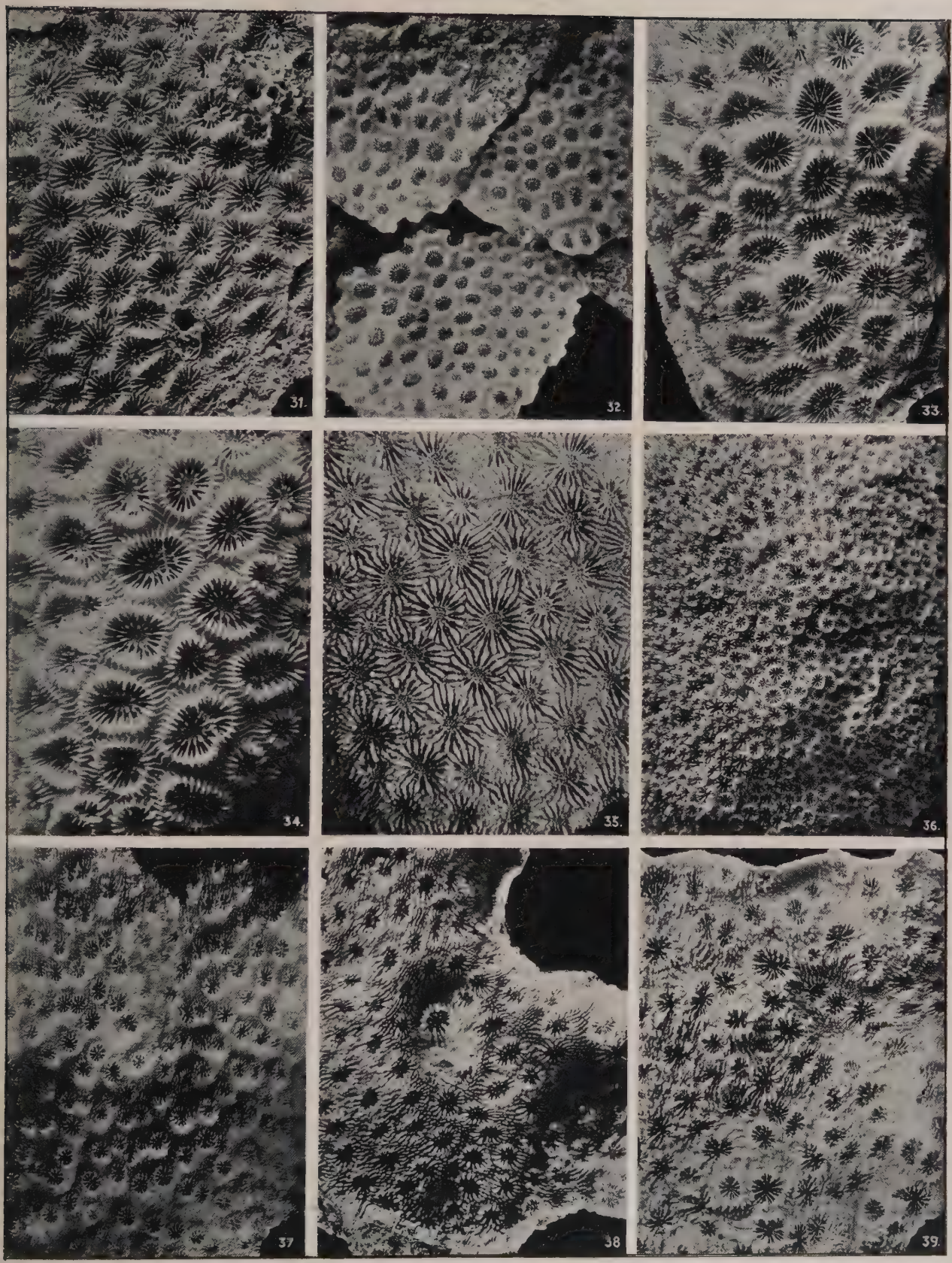
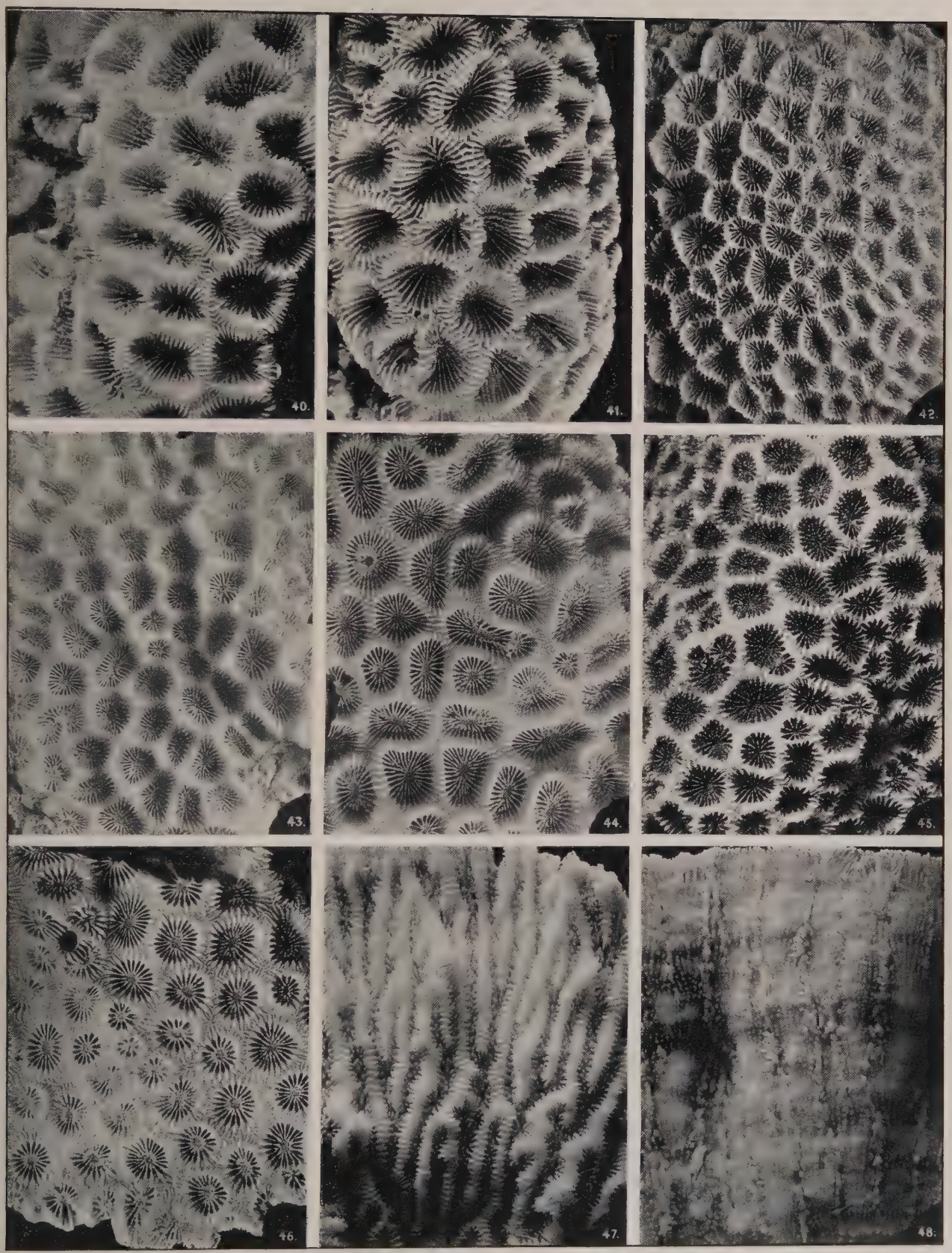


STANLEY GARDINER— ASTRAEIDAE (V).



STANLEY GARDINER——ASTRAEIDAE (VI).

ANTIPATHARIA.

By C. Forster-Cooper, M.A., *Trinity College, Cambridge.*

(With Plate LXV.)

The collection of Antipatharia obtained in the Maldive islands consists of eleven species all belonging to the subfamily Dekamerota (Schultze[1]) and to the subtribes Indivisae and Ramosae (Brook[2]).

As in many other groups of the Coelenterata, in the Antipatharia it is very difficult to decide what characters constitute a "species." In the main divisions there are characters of indisputable value sufficient to clearly mark off the subfamilies Dodekamerota, Dekamerota, and Hexamerota[3]. But, on considering the forms within some of these groups, we find not only a considerable amount of variation in the characters but also annectent forms between specimens, which might otherwise be regarded as distinct species. We are here only concerned with one subfamily, the Dekamerota, and with four of its suborders, Cirripathes, Stichopathes, Antipathes and Aphanipathes, within which all the specimens in the Maldivan collection are comprised.

The anatomy of the forms in these four groups yields us very few, if any, characters of assistance. The major anatomy is precisely similar for all of them, that is to say they have the ten mesenteries in the upper division of the coelenteron, the invariable six tentacles, and the gonads are formed in the usual way on the larger mesenteries. Further in the minute anatomy of those species which I have been able to study, this similarity is the same even

[1] Schultze, F. E., "Beit. zur System der Antipatharia." Ergebnisse einer zool. Forschungsreise von Kükenthal in *Abhandl. der Senckenberg. Naturf. Gesellsch.*, Bd xxiii. 1896.

[2] Brook, G., *Challenger Reports*, Vol. xxxii.

[3] The following is Schultze's classification which is used here.

Antipathidae (Verrill em Br.).

1. Subfamily Dodekamerota (Sch.).
   12 mesenteries arise in the upper coelenteric space.
   Leiopathes (Gray em Br.).

2. Subfamily Dekamerota (Sch.).
   10 mesenteries arise in the upper coelenteric space.
   Tribe I. Involutions of peristome wanting.
   Order Crustosae.
   Colonies cover foreign bodies with a crust, only the end branches being free.
   Savagliopsis.
   Order Indivisae.
   Colony free, in the form of a simple unbranched stem.
   Cirripathes,
   Stichopathes.
   Order Ramosae.
   Colony free, branched.
   Antipathes,
   Aphanipathes,
   Parantipathes.
   Tribe II. Peristome in the form of two short involutions penetrating into the coelenteric space.
   Schizopathes,
   Bathypathes,
   Taxipathes.

3. Subfamily Hexamerota.
   6 mesenteries arise in the upper coelenteric space.
   Cladopathes.

down to the distribution of the nematocysts on the tentacles, but unfortunately the preservation of many of the specimens, especially those with smaller polyps, was too bad for minute examination. The damage was probably done right at the beginning, the polyps owing to their extreme delicacy being quickly spoilt in the short time between their capture by the trawl and their preservation.

We have left then a certain number of characters on which to found our species, all of which are of a type in which we may expect, and usually find, great variation. They may be briefly summarised as follows:

1. Method of growth.
2. Colour.
3. Size of polyps, and their distribution on the corallum.
4. Shape of polyp and its tentacles.
5. Size, shape, and distribution of spines, and presence, or absence, of secondary spines.

Taken separately these characters are not of much use, for instance the growth of a colony may be easily altered by outside influences, such as currents, temperature or locality. Schultze quotes the case of *Savaglia* (*Gerardia*), which in its normal condition grows as a slender, well branched bush, a metre or more in height. In regions, however, where coral fishing is carried on, the fishing nets continually dragged over the bottom break down these tall colonies, and as a result forms of stunted growth with thick bases, sending out a large number of short branches, are found. If such a cause as this can alter the form of growth of a colony it is extremely probable that the many natural physical differences of environment, which obtain in different localities, must act in the same way and produce different forms of growth. The same author also points out that from this very reason forms, which have the same type of growth, must not of necessity be closely allied, since it may be the result of convergence due to these causes.

Of the value of colour we are in this group more or less ignorant, the only specimens obtained with a distinctive colouration being *Antipathes rubra* and *Cirripathes anguina*.

The shape of the polyp in the groups under consideration shewed too great similarity to enable any conclusion to be arrived at; all were either round or oval or both on the same corallum, but the younger polyps were frequently found to be more oval than the more fully grown ones. The height of the polyp is also so much a matter of relative contraction that too much stress must not be laid upon it. There is, however, a certain difference in absolute size between different forms, by which several groups may be roughly arranged.

There is left, then, the spines—their shape and arrangement—and here there seems to be a character of more promise. However, they will only serve to differentiate between species, there being no type of spine entirely confined to one group so as to mark off that group from all others. Also two forms differing in method of growth, size of polyp and other particulars, may yet have very similar spines, so that it is only by combining all these characteristics that we can form a working classification. Whether it will ultimately prove a natural one is doubtful.

All the figures are magnified 8 diameters unless otherwise specified. I have to thank Mr Crossland for three specimens from E. Africa.

ANTIPATHIDAE.

Subfamily **Dekamerota** Schultze.

Polyps in which ten mesenteries arise in the upper coelenteric space.

Order Indivisae Brook.

Colony free, in the form of a single unbranched stem.

Genus *Cirripathes* Blainv. em Brook.

An elongate unbranched corallum around which the polyps are distributed subspirally in several irregular rows, never in a single linear series.

1. *Cirripathes diversa* Brook. Pl. LXV. figs. 1, 1 *a*.

A small colony attached to a piece of nullipore, about 25 cm. long, subequally curled. Diameter of corallum 3 mm. at the base, tapering only very slightly to the top.

The spines are of two kinds, the primary stout, long and blunt at the end, slightly roughened and arranged in longitudinal rows, from eight to twelve rows being seen in the total circumference. The secondary spines are small and triangular, disposed quite irregularly among the larger ones.

Locality. Miladumadulu atoll, 24 *f.* Also recorded from Galle, Ceylon (Brook). Wasin island, E. Africa (coll. Crossland).

2. *Cirripathes anguina* (Dana). Pl. LXV. fig. 2.

A long sinuous unbranched stem, 40 cm. long (incomplete at basal end), greatest diameter 7 mm. tapering to the point. Corallum jet black.

Polyps dark rose pink, thus differing in colour from Dana's species in which they were green. There are six rather long tentacles. The size of the polyps varies from 2 mm. in oral diameter in the larger specimens down to small young ones 1 mm. across. The distribution of the polyps on the corallum is also irregular being generally one sixth of an inch apart; towards the top, however, they are more crowded together.

The spines are conical and equal in size, fairly stout and with a tendency to be arranged in spirals. They are, however, somewhat irregular in the lower part of the corallum. There are no secondary spines.

Locality. S. Nilandu, 30 *f.* Also from the Red Sea, Seychelles, and Ceylon.

3. *Cirripathes gardineri* n. sp. Pl. LXV. figs. 3, 3 *a*.

An incomplete stem 30 cm. long, sinuous with rough annular joints at rare intervals. Greatest diameter 3 mm. Corallum jet black.

Polyps straw yellow (in spirit). The latter are large, averaging 3 mm. high and 2 mm. in oral diameter. There is, however, variation in this respect, some being larger and some (younger intercalated polyps) being much smaller. Their distribution is all round the corallum but quite irregular as to position. The anatomy was found to be quite normal. There are six equally inserted tentacles, the two lateral ones being a little the longer.

The spines are irregularly placed, and bluntly conical with here and there a tendency to be knobbed at the end. A few exceedingly small triangular secondary spines are scattered irregularly among the larger ones.

This form is not unlike *C. anguina* in general appearance. The polyps are a good deal larger and the spines of slightly different shape; the colour is also different, a point however of very doubtful specific value. The presence of secondary spines, which are not found in *C. anguina*, is sufficient to distinguish the two forms.

Locality. Suvadiva atoll, 40 *f.*

Genus *Stichopathes* Brook.

An elongate unbranched stem with the polyps arranged on one side of the stem only.

4. *Stichopathes maldivensis* n. sp. Pl. LXV. fig. 4.

A single straight corallum 85 cm. long, tapering from 4 mm. at the base. Corallum jet black. The polyps were unfortunately in very bad condition. Enough could be made out, however, to shew that they were arranged on one side of the stem only, white in colour and with six long digitiform arms.

The spines were of two kinds, the primary ones stout, bluntly conical with rough sides and knobbed at the end. They are arranged in irregular spirals. The secondary spines are exceedingly small triangles scattered quite irregularly.

Locality. Haddumati atoll, 37 *f.*

Order Ramosae Brook.

Colony free and branched.

Genus *Antipathes* (Pall. em Schultze—*Antipathella* Brook).

5. *Antipathes spinosa* (Carter). Pl. LXV. fig. 5.

A small colony 7 cm. high, main stem erect giving off secondary branches at intervals of 2—3 mm. apart, which again bear very slender alternate pinnules.

The polyps are exceedingly small, arranged on one side of the pinnule only, white in colour.

The spines are rather long, sharp and hooked upwards, with a distinct spiral arrangement, which is somewhat obscured in places.

Locality. Hulule, 25 *f.*

6. *Antipathes chota* n. sp. Pl. LXV. figs. 6, 6 *a*, *b*.

The colony is erect and consists of a very thin black main stem, which almost immediately gives off other branches at different angles. These latter frequently are further branched. The colonies are small, the largest measuring only 8 cm. in total height.

The polyps are white, of variable size but all exceedingly minute, the average size being not more than ·75 mm. They are arranged on one side of the stem only. They are rather regularly placed at intervals of 1 mm. from one another. The tentacles are for the size of the polyp rather long.

The spines are also very minute and few in number, being conical or triangular, rather blunt and regularly arranged in spirals. About eight spines go to form a complete spiral.

Locality. This form seems to be the commonest in the Maldive islands, several specimens being obtained from different atolls. South Nilandu, 24 *f.*, North Male, 20 *f.*, 25 *f.*, and 30 *f.*, Mulaku, 30 *f.*, Felidu, 35 *f.*, Suvadiva, 37 *f.*

7. *Antipathes regularis* n. sp. Pl. LXV. figs. 7, 7 *a*.

A branch evidently torn off a larger colony. The main stem of the branch, 2 mm. in its widest diameter, is 15 cm. long. Six subsidiary branches varying from 15 to 20 cm. long are given off at irregular intervals, and these again give off long pinnules. The specimen on the whole is very sparsely branched. The corallum is black, turning to light brown in the smaller arms.

The polyps are white, placed very regularly on one side of the stem, and close together. All the full grown polyps are equal in size, but occasionally there are some young ones situated between the others.

The spines are stout, sharp, conical and hooked upwards. The arrangement is roughly eight to ten rows in straight lines. There are no secondary spines.

Locality. Fadifolu, 22 *f.*

8. *Antipathes rubra* n. sp. Pl. LXV. figs. 8, 8 *a—d*.

A few simple straight pinnules 10 cm. long, probably torn off a colony. The corallum and polyps are both a dark claret red.

The polyps are minute, 1 mm. in diameter, arranged on one side of the stem at regular intervals of 1 mm. The tentacles are comparatively long and digitiform.

This form obtained from several stations shews a good deal of variability especially in the arrangement of the spines. Unfortunately only small parts of the colony were brought up by the dredge on each occasion, so that the method of growth of the species remains in doubt. It appears, however, that branches are given off at an angle of 25 degrees from the stem.

The spines are of one type only but vary in size from minute conical forms pointing straight out from the stem to fairly stout sharp spines hooked and directed upwards. They are usually arranged in spirals of some regularity, but vary largely in the number of spines going to form a single spiral, and this even in the same specimen. Figures 8 *a* and *b* are from different specimens, while *c* and *d* are from different parts of a third form.

Locality. Suvadiva, 43 *f.*, 42 *f.* and 31 *f.*, Felidu, 35 *f.*, North Male, 28 *f.*

9. *Antipathes nilanduensis* n. sp.? Pl. LXV. figs. 9, 9 *a*, *b*.

Part of the corallum only, 5 cm. long, giving off sinuous branches from 4 to 7 cm. long, some of which again give off secondary branches, roughly at right angles.

Polyps of irregular size, the largest being 2 mm. across, grey in colour and with short tentacles. They are placed on one side of the corallum only.

Spines minute, conical, arranged in eight roughly straight lines, in parts with a tendency towards a spiral arrangement.

Locality. Felidu atoll, 36 *f.* and South Nilandu, 34 *f.* The South Nilandu form had rather larger polyps and the spines arranged in a more markedly spiral fashion.

10. *Antipathes pumila* Brook.

A single colony 25 cm. high, of the "bottle brush" type of growth. The specimen agrees with Brook's description in all particulars except that it is of greater size. There seems to be very little difference of any importance between this form and *A. abies.*

Locality. Kolumadulu atoll, 33 *f.*; also from Kurrachee (Brook).

Genus *Aphanipathes* Brook.

Corallum shrub-like with the branches free, or fan-like and reticulate. Spines elongate, equal or longer in the polyp areas. Polyps small and inconspicuous.

The difference between the two genera *Antipathes* and *Aphanipathes* appears to me to be founded on very slight grounds. The main point distinguishing them lies in the fact that in the latter the spines are longer in the polyp areas and penetrate into the polyps themselves. In view of the fact that in some forms of *Antipathes* the spines are irregular in size and often very variable in different parts of the corallum, it seems that too much stress must not be laid on this point of difference.

The other characters used by Brook to define the genus are also equally useless. "Polyps small and inconspicuous," "more or less oval outline," "tentacles usually very short," can all be applied to different species of the suborders *Antipathes* and *Antipathella*, the latter of which has already been merged into the former by Schultze. Probably further knowledge of the group at present under consideration will lead to the same fate.

11. *Aphanipathes plantagenista* n. sp. Pl. LXV. figs. 10, 10 *a.*

Colony of the "broom" type of growth. Two equal sized main stems 20 cm. in height giving off branches on one side of the corallum only; these again sending off irregular branches.

Polyps very small ·5 to 1 mm. in diameter, very regularly placed on one side only of the corallum at equal distances of ·5 mm.

Spines stout, sharp and triangular with a general tendency to be larger in the polyp areas and on the polyp side of the corallum. They are arranged in spirals and are not very numerous, about eight going to form one spiral.

This form is not unlike the description of *A. sarothamnoides* (Brook) but differs essentially in having smooth spines.

Locality. South Nilandu, 36 *f.*, and Felidu, 35 *f.*

EXPLANATION OF PLATE LXV.

Fig. 1. *Cirripathes diversa*, colony × $\frac{4}{5}$. *a.* Magnified to shew spines × 8.

Fig. 2. *Cirripathes anguina*, stem × 8.

Fig. 3. *Cirripathes gardineri*, part of corallum with polyps × $\frac{4}{5}$. *a.* Stem × 8.

Fig. 4. *Stichopathes maldivensis*, stem × 8.

Fig. 5. *Antipathes spinosa*, stem × 8.

Fig. 6. *Antipathes chota*, colony × $\frac{4}{5}$. *a.* Stem × 8. *b.* Two polyps × 8.

Fig. 7. *Antipathes regularis*, stem with polyps × 8. *a.* Stem × 8.

Fig. 8. *Antipathes rubra*, two polyps near end of a branch × 8. *a—d.* Stems × 8.

Fig. 9. *Antipathes nilanduensis*, colony × $\frac{4}{5}$. *a.* Two polyps × 8. *b.* Stem × 8.

Fig. 10. *Aphanipathes plantagenista*, colony × $\frac{2}{5}$. *a.* Stem × 8.

FORSTER COOPER——ANTIPATHARIA.

ARACHNIDA.

By R. I. Pocock, F.Z.S., *Superintendent of the Zoological Society's Gardens, Regent's Park; late Assistant in the Zoological Department of the Natural History Museum, S. Kensington.*

(With Plate LXVI.)

INTRODUCTION.

From the proximity of the Maldives and Laccadives to the coasts of Southern India and Ceylon, coupled with the well-known distributional powers of Spiders, it might have been foretold that the Arachnid fauna of these islands would prove to be essentially similar to that of the western portions of the Oriental Region. This has been demonstrated to the full by the collection brought back by Mr Stanley Gardiner. Some of the species, such as *Isometrus europaeus*, *Heteropoda regia* and *Uloborus geniculatus* which frequent human dwellings, have doubtless been introduced by human agency; but it is probable that the ancestors of the majority of the Spiders reached these islands on floating gossamer threads, the characteristic mode of travelling of the newly hatched young of most species, of the order Araneae. The presence of only one species of Scorpion, and that a form notoriously liable to dispersal by man's instrumentality, suggests that, unless in very remote times, there has been no connection between the Archipelagoes and the mainland of India of a nature suited for the migration of purely terrestrial species from the latter to the former; and this is further borne out by the almost complete specific identity between the faunas. A few species only have been described as new; but in each case there are no strong grounds for supposing the forms to be peculiar, except perhaps the representative of the genus *Desis*. The discovery of this genus is one of the most interesting features of Mr Gardiner's work, so far as Spiders are concerned; for, as stated below, it fills an important and hitherto regrettable gap in our knowledge of the range of this curious marine Spider.

In addition to the material collected by Mr Gardiner, I have been able to examine a small collection from the Suvadiva atoll in the Maldives, which was kindly sent to me by Mr G. P. Staunton, who, undaunted by the trials and hardships incidental to an enforced residence in this atoll as the result of shipwreck, bottled some specimens of spiders and forwarded them to me upon his arrival at a civilised port.

In conclusion, I may add that Mr Gardiner has kindly allowed me to figure certain of the more important structural features, which have never been previously illustrated, of some of the commoner species—a concession which I trust will add something to the value of this paper.

Order Scorpiones.

Family **Buthidae.**

Genus *Isometrus,* Hempr. and Ehrenb.

1. *Isometrus europaeus,* Linn.

Scorpio europaeus, Linn. *Syst. Nat.* ed. 10, p. 625, 1758 (= *maculatus* De Geer and most recent authors).

Locality. Minikoi; Fainu, N. Mahlosmadulu; Hulule, Male; and Havaru Tinadu, Suvadiva. Introduced by human agency from the Oriental Region all over the tropical and subtropical parts of Asia, Africa, and America.

Order Pseudoscorpiones.

Family **Cheliferidae.**

Genus *Garypus.*

2. *Garypus maldivensis* sp. n. (Pl. LXVI. fig. 1 *a—e*).

Colour a tolerably uniform testaceous yellow; the carapace from the anterior border as far back as the anterior of the two transverse depressions reddish-brown, the posterior portion marked like the first tergal plate, with a broad median greyish-black stripe, and a patch of the same colour on each side; the succeeding tergal plates marked with four spots, one, frequently broken up, on each side of the middle line and one near the lateral angle: ventral surface uniformly pale except for the presence of a spot on the side of the five posterior sterna; chelicerae brownish; chelae with hands and fingers deep reddish-brown, the latter sometimes bluish at base, the remaining segments pale; legs uniformly pale.

Integument of dorsal and ventral sides covered with fine coriaceous sculpturing which under a $\frac{1}{2}$ inch objective is resolved into a pattern of minute polygonal areas; the fingers of the chelae finely but decidedly granular, and sharply marked off from the hands in that particular; hairs short, simple, delicate and sparsely distributed, longer and coarser on the extremities of the legs than elsewhere.

Carapace much longer than wide, its posterior width scarcely greater than the length from the posterior border to the anterior edges of the anterior eye; ante-ocular portion narrowed and depressed, with rounded frontal lobes and a deep but wide median depression; post-ocular area marked with two transverse depressions, the anterior of the two mesially obsolete, distinct laterally; the posterior, defining the posterior fifth of the carapace, distinct and of almost uniform depth from side to side.

Chelae long: trochanter with a broad stalk, evenly rounded in front; femur slender, not stalked, gradually incrassate; tibia shorter than femur by nearly one-fourth the length of the latter, also slender and incrassate, the posterior border lightly convex, the anterior nearly straight; hand with a definite, short, cylindrical stalk, the expanded portion oval, the inner border more strongly convex than the outer, a little shorter than the tibia; fingers long and curved, the movable digit surpassing the length of the underhand by nearly one-third of its own length.

Chelicerae with basal segments armed with four long setae (as in fig. 1 *b*): a single seta at apex of movable digit; immovable digit arcuate, with hyaline dorsal crest; flagellum of movable digit long, slender with a variable number of longer or shorter digitiform terminal processes.

Measurement in mm. Total length, 5·5 with 2·5, length of chela, 7·5.

Locality. Midu, Addu Atoll.

Judging from its geographical distribution this species will probably prove to be nearly related to *G. personatus* Simon (*Proc. Zool. Soc.* 1901, p. 79) from the Malay Peninsula. The latter, however, was based upon a much smaller example, measuring in fact only 3·5 mm. in length. Moreover the name *personatus* has already been applied by Simon to a quite distinct form from the Sandwich Islands and cannot therefore be used for the Malay species. (*Arach., Faun. Hawaiien.* II. pt. v. p. 518, 1900.)

Order ARANEAE.

Family **Barychelidae.**

Genus *Sason* Simon.

3. *Sason cinctipes* Pocock.

Œcophlœus cinctipes Pocock, *Ann. Mag. Nat. Hist.* (6), IX. p. 49, Pl. III. A, fig. 1, 1892: *Sason cinctipes*, id. *Arachnida of British India*, p. 173.

Locality. Hulule, Male.

The genus *Sason* ranges from the Seychelles to Celebes. *S. cinctipes* has been recorded from Ceylon and doubtfully from Southern India.

Family **Scytodidae.**

Genus *Scytodes* Latr.

4. *Scytodes gilva* Thor.

Dictis gilva Thor., *Ann. Mus. Genova*, XXV. p. 83, 1887.

Locality. Inguradu, N. Mahlosmadulu.

Widely distributed in the Oriental Region.

The specimens collected in the Maldives have been compared with Burmese examples determined as *S. gilva* by Thorell.

Family **Uloboridae.**

Genus *Uloborus* Latr.

5. *Uloborus geniculatus* Oliv.

Locality. Minikoi; and Midu, Addu.

A widely distributed Oriental species.

Family **Arygopidae.**

Genus *Tetragnatha* Latr.

6. *Tetragnatha foveata* Karsch (Pl. LXVI. fig. 2 *a—c*).

Tetragnatha foveata Karsch, *Berl. Ent. Zeits.* XXXVI. p. 289, 1892.

Locality. Minikoi; Miladumadulu Atoll; Limbo-Kandu, N. Mahlosmadulu; Goidu, Goifurfehendu; and Suvadiva Atoll.

The specimens I refer to this species agree closely with the description given by Karsch of *T. foveata*, which was based upon an example from Ceylon.

For future verification, figures of the mandibles of the male (2 *a*) and female (2 *b*) and of the palpus of the male (2 *c*) are subjoined.

Genus *Leucauge* White.

Leucauge White (= *Arygroepeira* Emerton, *Tr. Conn. Acad.* VI. p. 331, 1885).

7. *Leucauge ventralis* (Thor.) (Pl. LXVI. fig. 3 *a*—*c*).

Meta ventralis Thorell, *Ann. Mus. Genova*, X. p. 423, 1877; Pocock, *Arachnida of British India*, p. 216.

Locality. Minikoi; Ereadu and Maungudu, Miladumadulu; Limbo-Kandu, Inguradu, Fainu and Kenurus, N. Mahlosmadulu; and Hulule, Male.

This species is very abundant in the Maldive Archipelago. It was originally recorded from Celebes and subsequently from Burma, where it is common, by Thorell.

The Maldive specimens have been compared and found specifically identical with examples from Burma determined by Thorell. Since this species has never been figured, I subjoin three figures showing the essential characters of the male and female (fig. 3).

8. *Leucauge celebesiana* (Walck.).

Tetragnatha celebesiana Walck., *Ins. Apt.* II. p. 222, 1837; *Arygroepeira celebesiana*, of Thorell and other authors.

Locality. Maungudu, Miladumadulu.

This well-known species ranges from India and Ceylon eastwards, at least as far as Celebes. It is far less common in the Maldives than *L. ventralis*.

Genus *Cyclosa* Menge.

9. *Cyclosa insulana* (Costa).

Locality. Maungudu, Miladumadulu; Limbo-Kandu and Inguradu, N. Mahlosmadulu; Kumfinadu, S. Mahlosmadulu; and Hulule, Male.

This species has a wide distribution in the tropics.

Genus *Aranea* Linn.

10. *Aranea punctigera* (Dol.).

Epeira punctigera Doleschall, *Verh. Nat. Vereen Nederland Indië*, III. p. 420, 1857.

Locality. Minikoi.

This species has a wide range in the Oriental Region.

11. *Aranea theïs* Walck.

Epeira theïs, Walck., *Ins. Apt.* II. p. 53, 1837.

Locality. Hulule, Male.

As generally recognised *A. theïs* has a wide tropical distribution in the eastern hemisphere.

12. *Aranea cicatrosa* Stol.

Meta cicatrosa Stolicka, *Journ. As. Soc. Bengal*, XXXVIII. p. 242, t. XX. fig. 5, 1869.

Araneus cicatrosus Pocock, *Arachnida of British India*, p. 226, 1900.

Locality. Maungudu and Manadu, Miladumadulu; Limbo-Kandu, Bodu Faro, Inguradu and Kenurus, N. Mahlosmadulu; Kumfinadu, Madu, Kanifuri, Maduwari and Turadu, S. Mahlosmadulu; Goidu, Goifurfehendu; Hulule, Male; Suvadiva; and Midu, Addu.

Common in India, Burma and Indo- and Austro-Malaysia.

Genus *Argyope* Aud.

13. *Argyope anasuja* Thor.

Argiope anasuja Thorell, *Ann. Mus. Genov.* XXV. p. 162, 1887; Pocock, *Arachnida of British India*, p. 222, 1900.

Locality. Very common throughout the Maldive Archipelago, specimens being taken from fifteen different islands; from Ereadu in Miladumadulu to Midu, Addu Atoll.

This species has been recorded from several localities in Southern India, but has not yet been taken in Ceylon. Although abundant in the Maldive Archipelago, it was not found by Mr Gardiner in Minikoi.

Genus *Gasteracantha*, Sund.

14. *Gasteracantha brevispina* (Dol.).

Plectana brevispina, Doleschall, *Nat. Tijdschr. Nederland Indië*, XIII. p. 423, 1857.

Gasteracantha brevispina Thorell and recent authors.

Locality. Minikoi; and in the Maldive group of wide distribution, but not obtained in Suvadiva or Addu nor indeed south of Hulule, Male.

Common in Ceylon, India, Burma and eastwards thence into Austro-Malaysia.

Genus *Poltys* C. Koch.

15. *Poltys illepidus* Koch.

Poltys illepidus C. Koch, *Die Arachn.* X. p. 97, fig. 21, 1843; Pocock, *Arachnida of British India*, p. 236.

Locality. Minikoi; Inguradu, N. Mahlosmadulu; Kumfinadu, S. Mahlosmadulu; Hulule, Male; and Suvadiva. Previously recorded from Ceylon and Indo- and Austro-Malaysia.

Family **Hersiliidae.**

Genus *Hersilia* Aud.

16. *Hersilia savignyi* Lucas.

Hersilia savignyi Lucas, *Mag. Zool.* 6ème Année, cl. VIII. p. 10, t. XIII. fig. 1, 1836.

Locality. Minikoi. Common in India and Ceylon.

Family **Agelenidae.**

Genus *Desis* Walck.

17. *Desis gardineri* sp. n. (Pl. LXVI. fig. 4 *a*—*e*).

Colour. Mandibles and cephalic region of carapace mahogany-brown; rest of carapace, legs, palpi and sternum, ochre-yellow; abdomen testaceous.

Eyes of anterior line straight by their centres; medians smaller than laterals, less than a diameter apart, distance between median and lateral greater than diameter of the former, about equal to transverse diameter of the latter; eyes of posterior line subequal and subequally spaced, the medians a little farther from each other (about two diameters) than from the laterals; the inner edge of the anterior median situated in the same longitudinal line as the centre of the space between the posterior median and lateral.

Mandibles normal in form, dentition as in *D. crosslandi*, the posterior tooth of the outer row small, separated from the anterior by a space which is equal to about three or four times its own height.

Palpi and *legs* of first and second pairs unspined; 3rd leg: tibia armed with 1 dorsal, 1 anterior, 1 posterior and 2 inferior distal spines, its protarsus with 11—12 spines, its tarsus with 6 inferior spines; 4th leg: tibia armed with 2 posterior and 2 inferior apical spines; protarsus with about 14 spines; tarsus with 6.

Epigyne very like that of *D. crosslandi*, but the orifices of the receptacula seminis less circular, more oval, the paired processes farther from their anterior rims, and with their apices closer together; the terminal linguiform process slightly clavate, much less curved than in *D. crosslandi*, lying indeed nearly in the same plane as the median area of the epigyne. Total length, 8 mm.; length of carapace, 3 mm.

Locality. Minikoi. A single female example was obtained from the reef at low tide, midway between Minikoi and Wiringili Islands.

It is possible that this species may prove to be identical with *D. crosslandi*, but for the present there is not enough material of either form to settle absolutely the constancy of the differential characters pointed out between the two.

The discovery of the genus *Desis* in the Laccadives fills an important gap in our knowledge of the distribution of the genus. Up to the present time it was only known from the Indo-Australian Seas, from New Zealand up to Singapore, and on the coast of South and East Africa from Grahamstown and Natal to Zanzibar. As I have already pointed out (*P. Z. S.* 1902, p. 391), the Zanzibar form, *D. crosslandi*, in spite of its geographical isolation, conforms to the type of species prevalent in the Australian Seas and not to that which is characteristic of South Africa. And Mr Gardiner's discovery of a species of the genus half-way between Singapore and Zanzibar is strong confirmation of the suggestion already put forward that representatives of *Desis* will be found in suitable spots all along the coast of Southern Asia.

Family **Oxyopidae.**

Genus *Oxyopes* Latr.

18. *Oxyopes hindostanicus* Pocock.

Oxyopes hindostanicus Pocock, *Journ. Bombay Nat. Hist. Soc.* XIII. p. 482, 1901.

Locality. Minikoi; Inguradu, N. Mahlosmadulu; Mahrus and Turadu, S. Mahlosmadulu; and Goidu, Goifurfehendu. Common in India and Ceylon.

Family **Thomisidae.**

Genus *Thomisus* Latr.

19. *Thomisus pugilis* Stolicka (Pl. LXVI. fig. 5).

Thomisus pugilis Stolicka, *Journ. As. Soc. Bengal*, XXXVIII. p. 246, 1869.

Locality. Inguradu, N. Mahlosmadulu; Madu, Hedufuri and Turadu, S. Mahlosmadulu; and Goidu, Goifurfehendu. Widely distributed throughout India.

The pearl-like granulation of the face is very characteristic of this species.

Family **Clubionidae.**

Genus *Olios* C. Koch.

20. *Olios lamarcki* (Latr.).

Thomisus lamarckii Latreille, *Gen. Crust. et Ins.* I. p. 113, 1806.

Locality. Minikoi; Fainu, N. Mahlosmadulu; Turadu, S. Mahlosmadulu; Hulule, Male; and Midu, Addu. Previously known from Madagascar, Ceylon and Southern India.

Genus *Heteropoda* Latr.

21. *Heteropoda regia* (Fabr.) (= *H. venatoria* of most recent authors).

Locality. Minikoi; and Inguradu, N. Mahlosmadulu. This species has been artificially distributed throughout the tropics by the agency of shipping.

22. *Heteropoda atollicola* sp. n. (Pl. LXVI. fig. 6 *a—c*).

♀. *Colour.* Carapace yellowish-brown, marked with blackish patches, the latter clothed with blackish hair; a posterior transverse pale stripe and a large pale central spot on clypeus; mandibles black, scantily clothed with pale hairs above; legs and palpi yellowish-brown, spotted and banded with blackish-grey patches above; dorsal side of abdomen mouse-brown, mottled with blackish patches above; ventral surface testaceous; sternum and coxae ochraceous. *Carapace* a little longer than wide, its dorsal surface horizontal, as long as tibia of 2nd leg, and as femur of 3rd or 1st. Posterior median *eyes* less than a diameter apart, more than a diameter from the posterior laterals, eyes of anterior line nearly straight by their upper edges, the laterals standing only a little higher, diameter of medians a little exceeding radius of laterals, the latter rather less than their diameter above the edge of the clypeus. Legs 2, 4, 1, 3, the 2nd rather less than four times the length of the carapace, measured from the base of the femur. *Vulva* with the two lobes meeting posteriorly in the middle line and circumscribing a longitudinally elliptical area bearing a narrow median longitudinal crest (fig. 6 *c*).

♂. Like the ♀ in colour except that the *mandibles* are yellow. Smaller and with considerably longer legs. *Carapace* a little shorter than tibia of 3rd leg. *Palpus* with tibial

apophysis (fig. 6 *b*) slender, slightly sinuous, directed forwards, slightly outwards, and slightly curved over at the point; beneath it at the base there is a short but strong angular process. For structure of palpal organ see fig. 6 *a*.

Measurement in mm. ♀. Total length 15, length of carapace 6·5, of 1st leg 24, of 2nd 27, of 3rd 23, of 4th 24. ♂. Total length 10, length of carapace 5, of 1st leg 25, of 2nd 30, of 3rd 22, of 4th 24.

Locality. Minikoi; Madu, S. Mahlosmadulu; Hulule, Male; and Suvadiva Atoll.

It seems improbable that this species will prove to be peculiar to the Maldive and Laccadive Archipelagoes, but I cannot refer the specimens to any Oriental species known to me. Three Ceylonese species, however, which I have not seen, have been described by Karsch (*Berl. Ent. Zeits.* XXXVI. pp. 291—292, 1892), namely *H. umbrato, eluta,* and *subtilis*; but the details given of the tibial apophysis in each case seem to preclude the probability of *H. atollicola* being identical with either of them. It is to be hoped that the publication of the figures of the vulva and of the palpal organ will enable the question to be definitely settled when Karsch's types have been re-examined.

Family **Attidae.**

Genus *Thotmes* F. Cambr. (= *Plexippus* auct. in part).

23. *Thotmes puykulli* Aud. (Pl. LXVI. fig. 7).

Attus puykulli Aud. and recent authors.

Locality. Minikoi. A widely distributed species.

I take the opportunity of illustrating the structure of the vulva (fig. 7), which has never before been figured, I believe.

Genus *Carrhotus* Thor.

24. *Carrhotus viduus* C. L. Koch; Thor. (Pl. LXVI. fig. 8 *a*, *b*).

Carrhotus viduus Thor., *The Spiders of Burma*, p. 378, 1895.

Locality. Minikoi. This species has been previously recorded from Ceylon, Burma, and elsewhere in the Oriental Region.

Fig. 8 *a* shows the tarsus of the palp of the male from the underside and 8 *b* the tibial apophysis of the same appendage, structures which have not been hitherto figured.

Genus *Hyllus* C. Koch.

25. *Hyllus pudicus* Thor. (Pl. LXVI. fig. 9 *a*—*c*).

Hyllus pudicus Thorell, *The Spiders of Burma*, p. 373, 1895.

Locality. Minikoi. A species hitherto recorded from Burma.

Some important specific characters of this species are shown by fig. 9 *a*—*c*.

POCOCK—ARACHNIDA.

EXPLANATION OF PLATE LXVI.

FIG. 1. *Garypus maldivensis*; *a.* carapace and anterior two terga, *b.* right chelicera from above, *c.* and *d.* flagella of two specimens, *e.* right chela from above.

FIG. 2. *Tetragnatha foveata*; *a.* right mandible of male from below, *b.* right mandible of female from below, *c.* palpus of male.

FIG. 3. *Leucauge ventralis*; *a.* lateral view of cephalothorax with palpus of male, *b.* lateral view of female to show form of abdomen, *c.* vulva of female.

FIG. 4. *Desis gardineri*; *a.* vulva from below, *b.* vulva from the side, *c.* lateral view of vulva of *D. crosslandi* Poc., *d.* distal end of left mandible from below, *e.* dorsal view of ocular area.

FIG. 5. *Thomisus pugilis*; anterior aspect of the face to show ocular arrangement, granulation and distribution of black pigment.

FIG. 6. *Heteropoda atollicola*; *a.* palpal organ from beneath with a larger illustration of the distal portion of the embolus and its sheath, *b.* the tibial apophysis, *c.* vulva.

FIG. 7. *Thotmes puykulli* ♀; vulva.

FIG. 8. *Carrhotus viduus*; *a.* tarsus of palp of male from beneath, *b.* portion of tibia of same appendage with apophysis.

FIG. 9. *Hyllus pudicus*; *a.* underside of tarsus of palp of male, *b.* tibial apophysis of the same appendage, *c.* vulva of female.

THE ALCYONARIA OF THE MALDIVES.

PART III. THE FAMILIES MURICEIDAE, GORGONELLIDAE, MELITODIDAE, AND THE GENERA PENNATULA, EUNEPHTHYA.

By Sydney J. Hickson, M.A., D.Sc., F.R.S., *Beyer Professor of Zoology in the Victoria University of Manchester.*

(With Plate LXVII.)

Our knowledge of the Alcyonarian fauna of the Indian Ocean is very imperfect. It is true that Gray, Milne-Edwards and Haime and many other writers of the earlier part of the last century have described species from the "East Indies," but the descriptions are in most cases so superficial and the localities given so vague or doubtful that their records are of very little value.

The only modern paper on the subject is that by Ridley (17) on the Alcyonaria of the Mergui archipelago. Neither the "Astrolabe," "Alert," the "Challenger," nor the "Gazelle" visited the district, and the Alcyonarians collected by the naturalists of the "Investigator" have not yet been described.

It is not surprising therefore that of the thirteen species of Gorgonacea described in this memoir from the Maldives no less than six appear to be new to Science. The classification of the Gorgonacea is still in a very unsatisfactory condition, but a thorough investigation of the anatomy of some of the leading genera is necessary before it can be placed on a more scientific basis. In the mean time I have decided to adopt as closely as possible the classification used by the authors of the Challenger volume on the Alcyonaria.

According to that classification then the Gorgonacea collected by Mr Gardiner belong to the families *Briareidae, Melitodidae, Muriceidae* and *Gorgonellidae.* The important families of Gorgonacea which, according to this classification, are not represented in the collection, are the *Sclerogorgiidae, Coralliidae, Dasygorgidae, Isidae, Primnoidae*[1], *Plexauridae* and *Gorgoniidae.*

The absence of any precious corals may have been disappointing but not surprising, as the family seems to be confined to regions of cooler water than that of the Maldives. The only statement we have concerning the occurrence of the precious coral in Indian seas is that made by Alcock (I. p. 291), "At one spot, not far from Trincomalee, M'Ardle found abundance of a beautiful pink coral which appears to be identical with the precious coral."

The absence of *Primnoidae*[1] and *Dasygorgiidae* is not surprising, as the members of these families are with a few exceptions usually found in deeper water than any investigated

[1] As I was correcting the proofs of this paper Mr Gardiner sent me a fragment (25 mm. long) of a Primnoid from Mahlos Atoll, 24 fathoms. It is closely related to *Stachyodes regularis* (W. and S.) discovered by the *Challenger* in 600 fathoms off the Kermadecs.

by Mr Gardiner. The absence of *Isidae* however is noteworthy. *Isis* was described by Steenstrup (fide W. and S.) from the Indian Ocean. It is common in some shallow water localities in the Pacific Ocean and coasts of the Malay archipelago.

As regards the absence of *Plexauridæ* and *Gorgoniidae* it may be remarked that, although there are no pronounced types of these families in the collection, some of the specimens approach them very closely in their general characters. One specimen of *Gorgonella verriculata,* for example, has such a thick coenenchym and such a black flaky axis that it would have been placed with certainty in the family *Plexauridae* had it not been found in the same collection with the other specimen which is clearly a *Gorgonella.* The new species *Elasmogorgia flexilis* again might with justice be placed in the family *Gorgoniidae,* the slight roughness of the surface being the only character at present known which justifies the inclusion of the genus in the family *Muriceidae.* The boundary line between the family *Muriceidae* and the *Gorgoniidae* and that between the *Plexauridae* and the *Gorgonellidae* are quite artificial; and it is probable that a rearrangement of the genera included in these four families will be found necessary in the near future.

The species of Gorgonacea described in this paper are

Family **Muriceidae.**

Acanthogorgia flabellum n. sp.
Bebryce sp.?
Acamptogorgia horrida n. sp.
Elasmogorgia flexilis n. sp.
Muricella perramosa (Ridley).
Acis sp.?

Family **Gorgonellidae.**

Gorgonella verriculata (M. E. and H.).
Juncella juncea (Pall).
Juncella flexilis (Studer).
Juncella elongata (Val).
Scirpearia furcata n. sp.
Scirpearella indica n. sp.

Family **Melitodidae.**

Melitodes variabilis n. sp.

I have also described briefly the only Pennatulid sent to me,

Pennatula murrayi Kölliker,

and a specimen of Nephthyid I received too late to be included in Part I,

Eunephthya maldivensis n. sp.

The species of the family

Briareidae

were described in Part I (9).

Family **Melitodidae.**

Melitodes variabilis n. sp. Fig. 11.

Locality. This species may be said, in general terms, to occur throughout the Archipelago in shallow water.

In my last paper on the *Alcyonaria* of the Maldives I published a preliminary note on these specimens, in which I pointed out the difficulty of the problem they present to the systematist. Since then I have made a further careful anatomical investigation of the specimens, not sufficient perhaps to enable me to write very definitely and clearly on the subject, but sufficient to convince me that without further researches on the reef I should not be justified in recognising more than one species.

The problem presents itself to my mind in this form. There are three characters in which the specimens show pronounced variations: 1. the colour of the spicules, 2. the length of the internodes, 3. the size of the spicules. These characters are, so far as I can judge, fairly constant within the individual colonies. All the specimens being fragmentary, however, this is a point that cannot be determined with absolute certainty.

1. The colour of the spicules may be a good character for the determination of a species of Alcyonarian, but as we know that at the Cape of Good Hope (Hickson 7) the spicules of the genus *Melitodes* do show striking variability in colour, and that in another Alcyonarian from the Maldives *Chironephthya variabilis* (9) there are very remarkable differences in the local distribution of spicule colour, it is at least very doubtful whether in this species the colour scheme of the spicules can be regarded as a good specific character.

2. The length of the internodes is just one of those characters which varies with local circumstances. It varies in an individual colony, the internodes of the main stem and primary branches being always shorter in proportion to their diameter and to the length of the nodes, than they are in the terminal branches. This, therefore, is not a character that can be used for determination of species without exact and precise knowledge of the local circumstances.

3. That the size of the spicules varies proportionately with the diameter of the internode, is, as a general statement of the facts, I believe, true. *Melitodes variabilis* is one of those species in which the size of the spicules from any one part of an internode varies considerably. It is only possible, by measuring the length of a considerable number of spicules from one internode and taking an average of their length, to arrive at any conclusion as to the figure to be taken to represent the length of the spicule of that internode. To feel strict confidence in the statement I have made it would be necessary to compare a large number of such averages from internodes of the same and different colonies. I have had neither sufficient time nor material to do this. I can only say that the comparisons of averages I have made point to this conclusion.

In other characters than these three I can find, at present, no noteworthy variations. The verrucae are of approximately the same size, similarly situated, similarly retracted in all cases, and although there are still many points that might with advantage be investigated there are no other characters that seem to be very variable.

This seems to me to be the case against the constitution of many species.

On the other hand Mr Gardiner writes to me as follows: "The point you have raised re *Melitodes* has interested me very much as it was one frequently discussed by my companion and myself. I held the opinion that they were all one species, and that it was only a question of looking to find two or more varieties in one colony, while Cooper held a contrary opinion. I then tried to find a mixture but without avail. This led me to look into the matter more closely, and then I noticed that they grew in patches, generally one form under each stone, though three or more forms were often in close proximity. I examined them to see if some were not more in the shade or subject to different conditions than others, *but this was not so.* I was surprised at this and therefore came to the conclusion that they were distinct species."

This valuable evidence from field notes is not conclusive, but it is of sufficient weight to shake one's confidence in the contrary conclusion arrived at from work in the laboratory. Further investigations are now needed on the reefs, and to assist these I will add in a tabulated form my notes on the specimens, passing in succession from the North to the South of the Maldive archipelago.

A study of this table shows that the variation in the specimens throughout the Archipelago is considerable and that with the present supply they cannot be grouped very satisfactorily into discontinuous groups, varieties or facies. Moreover we have evidence (*vide* Mr Gardiner's letter) that "three or four forms were often in close proximity," and from the table that the same or very similar forms may be found in very distant localities. As examples of this latter statement I would point out that the form with red nodes and red internodes occurs at Miladumadulu in the extreme north of the Archipelago and at Addu in the extreme South, and that the form with yellow nodes and yellow internodes occurs as far apart as Mahlos and Addu.

The spicules of all the forms I have examined are of three kinds: (1) bent spindles with the tubercles longer on the convex side than on the concave side, (2) plano-convex spicules with tubercles longer on the convex side, (3) short smooth rods. The first kind occur in the coenenchym of the internodes, the second kind in the nodes, and the third kind in the anthocodiae. In addition to these a few smaller straight spindles, clubs or other forms of spicules, occur in the internodes (fig. 11).

The spicules of the third kind are, in all the specimens I have examined, of very nearly the same size (0·07 mm. in length). Those of the second kind too are uniformly 0·13 × 0·07 mm. in size. The first kind however is very variable. In the Red-Yellow variety from Hulule, Male, they vary from 0·17—0·25 mm. in length; in the Red-Red variety from 0·14—0·27 mm., and in the Red-Grey variety from 0·15—0·25 mm. The averages were found to be approximately; Red-Yellow with a diameter of the internode 1 mm., average length of the bent spindles 0·214 mm.; the Red-Red variety with an average diameter of the internodes 2 mm., bent spindles 0·228 mm.; and the small Red-Grey variety with an average diameter of the internode 0·75 mm.: the bent spindles averaged 0·205 mm. in length.

Taking all these points into consideration I think the best course will be to regard all the specimens from the Maldives as belonging to one variable species, which for the present may be regarded as new. Several species of the genus have been described by Studer (21), Wright and Studer (26), and one by Ridley (19). Of these the species that seem to approach it most closely are *Melitodes laevis* (W. and S. from Amboina) which has a similar mode of

NODES		INTERNODES		
Colour	Diameter	Colour	Length	Diameter
Miladumadulu Atoll, 24 fathoms.				
Gray	1·75 mm., swollen	Gray	10 mm.	1 mm.
Red	Fragmentary	Red	Fragmentary	
Red	,,	Orange	,,	
Mahlos Atoll, 22 fathoms.				
Pink	2·25 mm.	Orange	20 mm.	1 mm.
Yellow	Fragmentary	Yellow	Fragmentary	
North Male, 24 fathoms.				
Red	2 mm., swollen	Dirty white	15 mm., fairly constant	1·5 mm.
Red	1·75 mm., swollen	White	20 mm.	1·25 mm.
Hulule, Male Atoll, 15—20 fathoms.				
Yellow	4 mm., swollen	Red	7—13 mm.	2 mm.
Yellow	2 mm., not swollen	White	22—24 mm.	2 mm.
Red	1 mm., swollen	White	5 mm.	0·5 mm.
Yellow	3 mm., slightly swollen	Pink	15 mm.	2 mm.
Hulule, Male Atoll. Under dead coral masses close to W. Reef.				
Red	1 mm., slightly swollen	Gray	10 mm.	0·75 mm.
Red	2 mm., not swollen	Red	7 mm., very variable	2 mm.
Red	1·25 mm., slightly swollen	Pale Yellow	8 mm., very variable	1 mm.
Red	1 mm., not swollen	Salmon	6 mm.	1 mm.
Felidu Atoll, 25 fathoms.				
Red	(Young colony)	Orange	(Young colony)	
Kolumadulu Atoll, 22 fathoms.				
Red	(Delicate fragment)	Gray		
Addu Atoll, 12 fathoms.				
Yellow	2·25 mm., swollen	Yellow	9 mm.	1·25 mm.
Red	(Fragmentary)	Red		
Addu Atoll, 25 fathoms. Outer slope.				
[1]Yellow	5 mm., swollen	Red	8 mm.	4 mm.
Orange	1·75 mm., slightly swollen	Yellow	7 mm.	15 mm.
Red	1·75 mm., slightly swollen	Red	7 mm.	1·5 mm.

[1] This specimen was a main stem. The others are apparently all branches.

branching, thin coenenchym, and similar spicules, and *Melitodes rubeola* (W. and S.) from the Arafura Sea which shows a similar colour pattern, pink nodes with white internodes, to that of some of the varieties of our species, but it differs from the former in the colour pattern, and from the latter in its mode of branching. The species may be described as "A delicate species branching in all planes with frequent anastomoses. Colour very variable; but the colour of the nodes and internodes frequently different."

Family **Muriceidae,** Verrill.

This large family is well represented in the collection. The characters are ill-defined, and it might be fairly maintained that such genera as *Muricella* and *Elasmogorgia* would be more correctly placed in the family Gorgoniidae. The genera represented in the family are *Acanthogorgia, Bebryce, Acamptogorgia, Elasmogorgia, Muricella* and *Acis.*

Acanthogorgia flabellum n. sp. (figs. 1 and 2).

Locality. Addu Atoll to seaward of atoll reef, 25 fathoms.

The specimens of this species are in three pieces, and possibly they all belonged to one colony.

The largest piece retains the main stem and a portion of the disc of attachment. It is 140 mm. in height and 140 mm. in width. The main stem is 2·5 mm. in diameter just above the disc of attachment, and the branches of the flabellum are on an average 1 mm. in diameter.

The branching is entirely in one plane and the branches anastomose freely to form a reticulate flabellum with meshes about 15 mm. from angle to angle. The coenenchym is very thin and the surface is rough, being beset with numerous regularly arranged tuberculate warts. The anthocodiae are cylindrical, 0·5—1 mm. in length, with slightly projecting spines at the free edge. They are numerous and crowded on most parts of the flabellum, and situated principally in the plane of the flabellum. Young zooids are interposed between the full-grown ones. The colour of the coenenchym and anthocodiae is white.

The axis is black in the older parts, brown in the younger. The axis is horny, but contains a core of bead-like calcareous bodies in definite chambers as in *Acamptogorgia spinosa* (Hiles 10). The spicules are colourless and very variable in shape. The spicules of the superficies of the coenenchym are so firmly interlocked and fused that they cannot be separated without injury. They are irregular tuberculated foliaceous clubs and branched spindles. In the anthocodiae a number of slightly bent spindles, from 2—3 mm. in length, are found. These are peculiar in that one half of their length is usually smooth and the other half tuberculated. At the free edge a few very long 0·5 mm. dagger-shaped spicules are found. In addition to these a number of very irregular foliaceous spicules occur both in the anthocodiae and coenenchym.

This new species is the first species of the genus to be found in the Indian Ocean. The other species occur in the Atlantic and Pacific Oceans.

Some species of the genus branch in one plane only and anastomoses of the branches are recorded in some of these (*A. inermis* Hedlund, 6; *A. schrammi,* D. and M., 2), but the formation of a reticulate flabellum such as we find in this species is unusual. The anthocodiae are distinctly smaller than usual. In several species described by Studer (20) they range from 1—2 mm. in *A. truncata,* to 4—8 mm. in *A. verrilli.* In this species they are rarely over, and

more frequently under 1 mm. in height. In the literature of the subject there is very little reference to the structure of the axis. It is usually described as being horny (Hedlund, Wright and Studer), and it is horny and fibrous in the specimens of *A. armata* from the Cape (8), and *A. spinosa* from Funafuti, which I have had the opportunity to examine. The species therefore in this respect seems to be peculiar.

In a genus with such variable spicules as *Acanthogorgia* it is difficult to determine species or to consider the relations of species by this character alone. The spicules of the new species are not unlike some of those figured by Hedlund from *A. aspera*, but they also resemble the spicules described by Ridley (19) from *Echinogorgia flabellum*, and by Kölliker (13) from *Paramuricea spinosa*. Studer (22) has some hesitation in accepting the identification of Hedlund's species as *A. aspera* (Pourt), but the figures Studer gives of *Acanthogorgia horrida* have a general family resemblance to those of Hedlund's *A. aspera* and of *A. flabellum*. As a matter of fact it is really very difficult to draw any important distinction between the spicules of *Paramuricea*, *Echinogorgia* and *Acanthogorgia*, and there can be no doubt that the three genera are closely related. I had some hesitation in placing the new species in the genus *Acanthogorgia*, thinking it might be the same as the Indian species *Paramuricea cancellata* of Studer (*Echinogorgia flabellum* Ridley), but an examination of Ridley's specimen in the British Museum convinced me that it is more correctly placed in the genus *Acanthogorgia*. Of the species of *Acanthogorgia* it seems to be most closely related to Hedlund's *A. inermis* from 30 fathoms off Hong Kong.

The species may briefly be described as follows: Colony branching in one plane to form a reticulate flabellum. Coenenchym thin. Anthocodiae small, ·5—1 mm. in height. Axis with a core of calcareous beads.

Bebryce, sp.?

Locality. S. Nilandu, 30 fathoms. S. Passage of Atoll.

One small fragment of a Gorgonian having a superficial resemblance to a *Muricella perramosa*, but light brown in colour instead of crimson-red, belongs probably to a species of Bebryce.

The specimen is 50 mm. in height and bears three short branches formed probably by dichotomy. The diameter of the branches is 1·75 mm. Many of the Zooids are only partially retracted, the whole of the calyx being above the surface of the coenenchym, but in other places the coenenchym almost completely covers the calyx, forming verrucae 1 mm. in height. The axis is horny, fibrous, not calcareous.

The remarkable character of the spicules is one of the features of the genus, and the spicules of this specimen agree fairly well with the description and size given by Kölliker (13).

The genus has been found in the Mediterranean (*B. mollis* von Koch, 12) and a new species was described by Whitelegge (25) from Funafuti *B. studeri*. The Maldive specimen does not belong probably to either of these species, but as it is so fragmentary I do not feel justified in making a new species for it.

If Whitelegge and I are correct in referring our specimens to this genus, its geographical distribution is most remarkable.

Acamptogorgia horrida, n. sp. (figs. 3 and 4).

Localities. S. Nilandu, 25 fathoms. Suvadiva. Lagoon, coarse sand and rubble, 39 fathoms.

There were two fairly complete colonies attached to stones and five fragments from Suvadiva. Judging from the specimens it may be inferred that the colonies are about 100 mm. in height, and they consist of about nine or ten branches, which in some cases branch again, given off from a short main stem. In some places the branching is apparently dichotomous, but it is not invariably so. The branches meet the main stem at an angle which is nearly a right angle. The branches are not given off in one plane. The main stem and the basal parts of some of the branches are in the specimens bare, zooids and coenenchym alone occurring on the younger parts.

The coenenchym is thin, the terminal branches are 0·7 mm. in diameter.

The calices are not very prominent, but each is surrounded by a crown of spines as figured by Miss Hiles (10) in *A. spinosa*. These spines project 0·1 mm. The diameter of the calyx as measured from spine to spine is 0·3 mm.

The axis is black or brown, and none of the pieces I have examined contain lime; the core of the axis however is divided into a series of chambers by vertical partitions as described by Hiles for *Acamptogorgia spinosa*.

The surface of the calices and coenenchym bristles with the smooth spines of the remarkable spicules so characteristic of the genus. Each of these consists of a tripod base, the limbs of which are about 0·15 mm. in length and covered with numerous rough tubercles, and a single sharp smooth spine 0·2 mm. long which projects freely at the surface. The base varies according to the position. On the coenenchym there are usually three limbs to each spicule, on the calices two, but many intermediate forms are found in which one of the three limbs is very small. Four limbs are sometimes found. The limbs too are sometimes foliaceous and may interlock with one another or with the limbs of neighbouring spicules.

In addition to these spicules there are some large slightly bent tuberculated spindles at the surface of the coenenchym which are about 0·6 mm. long × ·1 mm. broad.

The species seems to be most closely related to *Acamptogorgia spinosa* (Hiles) from Funafuti, but differs from it in being more robust in habit, less finely branched, much more spiny in appearance, and in the presence of the large spindles of the coenenchym.

Elasmogorgia flexilis, n. sp. (figs. 5, 6 and 7).

Locality. Suvadiva, 20 fathoms. In a passage towards the lagoon. And 37 fathoms. Hard sand near a passage.

Some very delicate thread-like forms must be provisionally referred to the genus *Elasmogorgia*. Studer (26), who established this genus, considered that it might be the same as Gray's (5) *Filigella*, but owing to the loss of the type specimen and the inadequate description given by Gray, he very properly proposed a new name for it. I have compared the specimens obtained by Mr Gardiner with the description and figure given by Gray, and think that it is highly probable that they belong to his genus. For the reasons given by Studer, however, I refer it to the genus *Elasmogorgia*.

There are in all ten or eleven specimens varying in length from 240—300 mm. Two of them are adherent to stones with a small disc of attachment.

As in so many other cases, I had some hesitation in placing these specimens in any of the known genera. They seem to differ from *Muricella* in being much less ramified and in having much smaller spicules. They agree better in the character and size of their spicules with the genus *Stenogorgia* (Verrill), but this genus is more robust and much more ramified. They differ from the description of *Filigella gracilis* given by Gray in two particulars. Gray describes the axis as "rather rigid"; the axes of these specimens are very flexible. Gray further describes the verrucae to be 1 inch or $\frac{3}{4}$ inch apart; they are much closer set in these specimens.

The specimens agree much more closely with the description given by Studer of *Elasmogorgia filiformis*, but our specimens are rather more delicate and the spicules much smaller. The spicules of *Elasmogorgia filiformis* are from 0·13 to 0·62 mm. in length, whereas in our specimens they rarely exceed 0·2 mm. in length and the great majority are not over ·15 mm. in length. They differ moreover in having fewer and coarser tubercles.

There can be little doubt that this is a new species, and it can be easily distinguished by the size and character of the spicules.

Elasmogorgia filiformis (Studer) was found in 28 fathoms S. of Papua, *Filigella gracilis* (Gray) off Cape Frio, Patagonia.

All the specimens are unbranched except one, and this gives off only a single branch at right angles to the main stem. The average diameter of the stem is between 0·5 and 1 mm., and at the free extremity there is a knob-like swelling 1·2 mm. in diameter very similar to that shown in *Filigella* by Gray. The coenenchym is thin but not transparent. The verrucae project slightly from the coenenchym and completely enclose the calices. Their longest diameter, that parallel to the axis, is 1 mm. They are situated at distances of 2 or 3 mm. apart, and are not arranged in definite rows on opposite sides of the stem, but are irregularly distributed round it. The spicules of the coenenchym are stout, rough, irregular, warty spicules of various sizes, usually 0·15 mm. in length, but rarely exceeding 0·2 mm. × ·08 mm. In the tentacles there are a few delicate needles.

The axis is brown to dark-brown in colour and quite devoid of lime.

The colour of all the specimens is white.

Muricella perramosa Ridley (18).

Localities. S. Nilandu, 30 fathoms. S. passage of Atoll, 1 specimen. Suvadiva Atoll, 33 fathoms. In passage, 2 specimens.

Several species have been placed in this genus, but few of them have been at all adequately described. *Muricella humosa* (Esper) and *Muricella tuberculata* (Esper) were probably obtained in the East Indies.

The specimens from the Maldives agree most closely however with *Muricella perramosa* from Mauritius, 90 fathoms, described by Ridley (18).

The specimens are all small, being 80, 60 and 40 mm. respectively in height. Ridley's largest specimen was 500 mm. in height by 475 mm. in extreme breadth. It is noteworthy

that the specimens from both localities exhibit some branches which are bare or torn, suggesting that they might possibly have been bitten by fish; but they are also permeated by a parasitic alga (?) which has a milk-white flocculent appearance in spirit.

The spicules are of the characteristic shape, those of the cortex being about ·25 mm. × ·07 mm., and those of the verrucae 0·15 mm. × ·06 mm., but they exhibit a good deal of variation in the size.

The colour of the specimens is crimson-red.

Genus *Acis*, sp.?

Locality. South Nilandu, 30 fathoms. North Male, 20 fathoms.

When this paper was nearly ready for the press and I was arranging the collection in separate bottles, I came across three fragments of Gorgonians which clearly belonged to species distinct from any I had described.

These I now find undoubtedly belong to the genus *Acis* which is characterised by the large thick spindle-shaped spicules of the cortex.

Three species of this genus are known: one (*A. guadalupensis*, D. and M.) occurs in the West Indies, another (*A. orientalis*, Ridley) in the Mauritius, and a third was discovered by the Challenger (*A. pustulosa*, W. and S.) off Japan. The occurrence of the genus in the Maldives is therefore a matter of some interest.

In some respects our specimens come close to *A. orientalis*, and I was tempted to regard them all as belonging to this species, but the remarkable colour differences and the fragmentary condition of our specimens render it necessary for me to consider the species doubtful.

The first specimen is a delicate branching form with yellow calices and orange-coloured coenenchym. This orange colour is due to the fact that most of the large coenenchym spicules are yellow with a dark red core. The coenenchym is thin, the branches about 1 mm. in diameter.

The second specimen consists of two branches 40 mm. and 25 mm. in length. They are much more robust than the branches of the first specimen, being 2 mm. in diameter with a much thicker coenenchym. The spicules of the outer layer of the coenenchym are white and of the inner layer red.

The third specimen—the only one from N. Male—resembles the second specimen from S. Nilandu in form and size, but the spicules are all red.

The axis of all the specimens is horny with a core of lime.

Family **Gorgonellidae** Verrill.

Gorgonella verriculata, Milne-Edwards and Haime. Syn. *Gorgonia reticularis*, E. and S. (?).

Localities. N. Male, 20 fathoms W. of Atoll; across a passage. Mahlos Atoll, 23 fathoms; inner part of passage to S.E.

One dried specimen of which the record of locality is lost.

It is with some hesitation that I place these specimens in Milne-Edwards and Haime's species. The description given by these authors is very inadequate, and Studer's (20) account of a specimen which he attributes to the species does not add much to our knowledge. The

specimens are placed in the genus *Gorgonella* on the grounds that the axes contain a considerable amount of lime, that the coenenchym is moderately thick, that the verrucae are slightly or not at all prominent, and that the spicules are of the general size and shape common to many species of the genus.

The specimen described by Ridley (17) under the name *Gorgonella umbella* Esper, resembles our specimens to some extent, but as the author does not state what the character of the axis is, it may be a matter of some doubt whether they really belong to this family at all.

There is some difficulty in drawing a hard line of distinction between this genus and *Verrucella* which it resembles in many respects. But *Verrucella* appears to have a more delicate habit, to have smaller spicules and to have more prominent verrucae. The verrucae are moreover situated principally on the sides of the branches and not scattered all over as they are in our specimens.

The important characters which distinguish our specimens may be summarised as follows:—

Corallum branching profusely in one plane to form an elaborate reticulate flabellum. Verrucae very slightly or not at all prominent, unevenly scattered over the surfaces of the main branches and branchlets. Coenenchym moderately thick. Axis containing a considerable quantity of calcium carbonate. Spicules of the coenenchym, spindles and a few double clubs.

The colour of our specimens is very pale brown or white. In this respect they differ from Studer's specimen which he describes as "lackroth."

The largest specimen (from N. Male) is about 125 mm. in height and 150 mm. in width. It branches profusely in one plane and the branches anastomose freely to form meshes, many of which are 20—30 mm. long by 5 mm. broad, but in the course of the reticulum there are many much smaller meshes, 5 mm. × 3 mm. or less. The terminal branches are about 2 mm. in diameter. The anthocodiae are withdrawn completely, but the retracted tentacles can be clearly seen through an open gap in the coenenchym. The verrucae are very slight in most parts of the colony, rather more pronounced in others.

The general appearance of this colony is very similar to Ellis's picture of *Gorgonia reticularis* (3), but unfortunately this author gives no description of the species.

The spicules of the coenenchym are of two kinds. The majority are blunt spindles with crowded exfoliating tubercles and their length is fairly uniformly 0·1 mm.; but in addition to these there are a few small double-heads ·043 mm. in length. In the tentacles there are spindles, some straight and some slightly bent, smoother and flatter than the spindles of the coenenchym, and usually a trifle longer. The only statement I can find about the spicules of this species is that of Studer (20) "Die Spicula sind warzige Spindeln und Doppelkeulen."

The second specimen (from Mahlosmadulu Atoll) is in several pieces, and it is impossible to estimate at all accurately the size and shape of the colony as a whole. The coenenchym is rather thicker than in the N. Male specimen and the zooids are even more contracted, so that the verrucae have the appearance of small pores at the summit of very slight prominences.

In fact, taking all the superficial characters together, it is more like a Plexaurid than a Gorgonellid. The investigation of the spicules and other microscopic characters, however, leaves little doubt that it belongs to the same species as the N. Mahlos specimen.

The dried specimen from an unknown locality is only a fragment, and is noteworthy only from the fact that it is of a rufous colour.

Genus *Juncella*.

In the family *Gorgonellidae* there are four genera recognised by systematists, which are undoubtedly closely related. These are *Juncella, Ellisella, Scirpearia* and *Scirpearella.* They are all either unbranched or, as compared with other Gorgonellids, slightly branched, and the coenenchym is usually thick.

All the known species were at one time included in the genus *Juncella* and the first attempt to separate them was made by Studer (20) in 1878. This author placed the species with prominent verrucae and with club- or double club-shaped spicules in the genus *Juncella,* and those with not prominent verrucae and without club-shaped spicules in the genus *Ellisella.*

The use of the distinction between prominent and not-prominent verrucae for generic purposes is very inconvenient and the source of many mistakes. There are many specimens that on the ground of the character of the spicules should be placed in the species *Juncella* (*Ellisella*) *elongata* which have prominent verrucae. Ridley (18) points out moreover that in his specimen of *Juncella juncea* the verrucae are withdrawn above, but prominent and appressed below. The determination of the question whether any particular verruca is to be called prominent or not prominent is in many cases very difficult, and can be of little scientific importance unless all the specimens compared have been killed and preserved in the same manner. The question therefore becomes one in which we are driven to determine the generic distinction between two alcyonarians by the character of the spicules alone. In some cases perhaps this may be necessary and possible, but the spicules technically known as clubs show much variation, and when the handle is enlarged are very similar to spicules known as double-clubs. I doubt very much whether it is wise, in the present state of knowledge concerning the growth of spicules, to put too much stress upon fine distinctions of their shape. It may be pointed out in this connection, that the Cape specimens, which in a former paper (7) were referred to, the species *Juncella elongata* would, if judged by the character of the spicules, alone be placed in a distinct genus. On these grounds therefore I have little hesitation in referring all the species hitherto included in the two genera *Juncella* and *Ellisella* to the former genus, thereby suggesting the abolition of the latter.

The genera *Scirpearia* and *Scirpearella*, however, appear to me to be still good genera. The arrangement of prominent verrucae in two rows in the former genus and in a spiral manner in the latter, combined with other characters, renders them relatively easy of identification.

The principal species of the genus *Juncella* in its wider sense that are now known may be arranged as follows:

With club-shaped spicules.
- *Juncella juncea* (Pallas).
- *Juncella gemmacea* (Milne-Edwards).
- *Juncella flexilis* (Studer).
- *Juncella fragilis* (Ridley).
- *Juncella barbadensis* (W. and S.).
- *Juncella racemosa* (W. and S.).

Without club-shaped spicules.
- *Juncella elongata* (Val).
- *Juncella calamus* (Studer).
- *Juncella maculata* (Studer).
- *Juncella spiralis* (Hickson).

Juncella hepatica Klz (11), from the Red Sea, has been obtained only once in a fragmentary condition and may not be distinct.

Juncella funiculina M. and D. (2), from the W. Indies, and *Juncella laevis* Verrill (23), from Hong Kong, are not sufficiently well known to classify in this system.

Of these species the most widely distributed and best known are:

Juncella juncea, from Bourbon (Gray), Mauritius (Lamouroux), Ceylon (Ridley), Ceram (Rumphius), Torres Straits (Challenger), N.W. Australia (Studer), Queensland (Ridley), Singapore (Studer, 21), Muscat (Man. Mus.). It appears to be confined to shallow water, 7—50 fathoms.

Juncella gemmacea, from the Red Sea (Klz., etc.), Torres Straits (Challenger), N.W. Australia (Studer), Burmah (fid. Ridley), Queensland (Ridley), Singapore (Studer and Klz.). It extends from shallow water to 80 fathoms.

Juncella elongata, from Atlantic Ocean (Pallas), West Indies (E. and S.), N.E. Australia (Ridley), Cape of Good Hope (Hickson). It may be regarded as very doubtful, however, whether the species was in all cases correctly identified by these authors.

Of the less widely distributed species:

Juncella flexilis was found between Flat Island and Mauritius, 25 fathoms (Studer), and at Ternate (Germanos).

Juncella fragilis, Queensland and Mergui (Ridley), in shallow water.

Juncella barbadensis, Sombrero Island, 450 fathoms (Challenger).

Juncella racemosa, Japan, 345 fathoms (Challenger).

Juncella calamus, N.W. Australia, 50 fathoms (Studer) and Queensland, 4 fathoms (Ridley).

Juncella maculata, Torres Straits and Banda (Challenger), N. W. Australia, 50 fathoms (Studer).

Juncella spiralis, Cape of Good Hope, 25 fathoms (Hickson, 8).

The principal difficulty the systematist meets with is to distinguish between *J. gemmacea* and *J. juncea*.

These two species agree in having more or less prominent verrucae according to the method employed of capture and preservation, in having a thick fleshy coenenchym, in being slightly branched or unbranched, in their great size (700—900 mm. in the case of large specimens), and in having coenenchym spicules consisting of clubs and double stars from 0·05—0·1 mm. in length.

In *Juncella juncea*, however, the verrucae are not usually crowded, there is only a single bare track in some specimens, the colour is usually dark-red, rarely white. Most of the specimens are unbranched and may reach a great length without branching.

In *Juncella gemmacea* the verrucae are usually more crowded, and there is a bare track on both sides of the coenenchym, which in larger specimens is usually invaded by verrucae; the colour is much more variable, orange-red, orange, coral-red, white or cream coloured. Specimens when of large size are usually branched. The smaller specimens of *J. gemmacea* are unbranched, hence the difficulty.

As pointed out by Ridley (17) these species are so variable that it is very difficult to distinguish them. Perhaps they should be merged into one variable, widely distributed species.

As regards *Juncella fragilis*, Ridley himself felt doubtful whether it was a good species. Probably it is a young form of *J. juncea*. It is unbranched.

Juncella flexilis may also be but a young form of another species. It is unbranched, dark-red in colour, and distinguished by its slender axis and thin coenenchym. The verrucae are arranged in two rows on the lower part of the stem, but in the upper parts are not so restricted.

Juncella spiralis is of relatively small size when compared with the larger specimens of *Juncella juncea* and *J. gemmacea*, and is distinguished by the pronounced single bare track and by the spiral form.

Juncella elongata, *J. maculata* and *J. calamus* were formerly placed in the genus *Ellisella* and agree in having no typical club-shaped spicules.

J. elongata is a large, branching species, very similar to *J. gemmacea* in form. It may be red or pale pinkish-yellow. The surface may be smooth (Studer) or the verrucae very prominent (Ridley).

It is very difficult to distinguish *J. maculata* from *J. elongata*. The specimen described by Studer was only 25 cm. long. The colour was orange-red, with the coenenchym immediately surrounding the verrucae red.

J. calamus may be but a variety of the same species. It was found in the same dredging as *J. maculata*, and the only material feature in which it differs from it is that in the lower part the verrucae are arranged in five rows. It is unbranched.

J. barbadensis and *J. racemosa* are both from deep water and appear to be quite distinct species. The former seems to be related to *J. flexilis*, but may be distinguished by the very long peduncles of the verrucae and the larger size of the club-shaped spicules.

J. racemosa is distinguished by the peculiar and exceptional method of its branching.

Juncella juncea, Pallas.

Localities. S. Nilandu. W. passage of Atoll, 25 fathoms (Spec. A). N. Male Atoll, 20 fathoms, W. of Atoll. Across a passage (Spec. B).

Specimen A was fragmentary, 70 mm. long, 5 mm. in diameter. Colour dark-red. The verrucae project but slightly and are about 1·3 mm. in length and breadth. They are directed towards the apex.

The spicules are clubs and very spiny double clubs, the former about $0{\cdot}1 \times 0{\cdot}025$ mm., the latter $0{\cdot}1 \times 0{\cdot}05$ mm. There are no spindles or double stars. The spicules of this specimen are very similar to those figured by Kölliker.

Specimen B is 370 mm. long and about 5 mm. in diameter. It was not branched. Colour dark-red. Verrucae numerous, projecting, turned towards apex. The spicules are very similar to those of Specimen A.

It is impossible to determine whether these specimens are more correctly placed in this species or in the species *J. gemmacea*, but as there is no sign of ramification I have placed them with *J. juncea*.

Juncella flexilis, Studer (20).

Locality. Hulule, Male, 25—30 fathoms.

A very delicate unbranched specimen, may be provisionally referred to Studer's species. It is 140 mm. long and barely 1 mm. in diameter. The verrucae are prominent but not so prominent as in the type. The coenenchym is thin. The spicules are clubs with thick handles (i.e. they are intermediate in form between typical clubs and double clubs) ·09 mm. in length, and a few tuberculate spindles. The colour is red.

The specimen seems to be more delicate than the type which, judging from the figure, must have been at least 2 mm. in diameter; but in the thinness of the coenenchym, the shape and size of the spicules and the colour, it is very similar to the description of the species. The type specimen was obtained off Mauritius in 25 fathoms.

It is quite possible that these specimens, however, are only young stages of *Juncella juncea*. We have no information at present as to the mode of growth of the Alcyonarians of this genus, and it may be that in the early stages they grow rapidly in length in order to reach a level in the water where food can be more readily obtained, and that the growth in the thickness of the coenenchym takes place at a later stage.

Juncella elongata (Val).

Localities. Hulule, Male Atoll, 25—30 fathoms, close to edge of reef. Specimen A.
S. Nilandu, 25 fathoms. W. passage of Atoll. Specimens B and C.
S. Nilandu, 30 fathoms. W. passage of Atoll. Specimen D.

As there are only fragments of the specimens, which I believe should be placed in this species, the identification may not be regarded as very satisfactory. All the specimens are unbranched.

Specimen A is in three pieces and reached a total length of 315 mm. The total diameter is $3\frac{1}{2}$ mm., and the axis is 2 mm. in the middle region. Nearer the base the coenenchym is relatively thin or very thin, and nearer the apex much thicker.

The colour of the coenenchym is pale-pink and the verrucae are throughout shallow domes, white in colour.

Specimen B is a fragment 60 mm. long by 3 mm. in diameter. The surface is almost smooth and pale-red in colour.

Specimen C is about the same length but much more slender.

Specimen D is 230 mm. long, with verrucae scattered and becoming prominent towards the distal end, but with an almost smooth coenenchym near the base. Colour orange-red.

The spicules are double clubs, warted spindles, and a few more elongated spindles with fewer tubercles arranged in regular rows. The warted spindles and double clubs vary in size from 0·08—0·085 mm. in length. Some of the pointed spindles are 0·1 mm. in length. There is evidently a good deal of variation in the shape of the spicules. In A and C the double clubs predominate, in D the warted spindles predominate. In C there are many unsymmetrical double clubs similar to those found in *Juncella juncea*.

The colour, the prominence of the verrucae and the definiteness of pronounced tracks free from verrucae, are also characters in which the species shows much variation.

Scirpearia furcata, n. sp. Figs. 8 and 9.

Localities. S. Nilandu, 25 fathoms. W. passage of Atoll.
N. Male, 20 fathoms. W. across a passage.

Two specimens were obtained from S. Nilandu. One was 90 mm. long × 1·5 mm. diameter, the other 75 mm. × 4 mm. diameter. Both exhibit an orange-red coloured coenenchym with dark-red dome-shaped verrucae, closely crowded but separated into two groups by broad spirally directed bare tracks. The former more delicate specimen has a single branch which is bifurcated at its extremity.

The spicules are principally warted spindles of a dark orange colour, 0·1 mm., a few paler double clubs 0·1 mm., and double stars 0·75 mm.

The specimen from N. Male is only a fragment.

The species differs from *S. ochracea* and *S. flagellum* in having less prominent verrucae, in the size of the spicules, and more particularly in the character of branching which is shown in one specimen.

Scirpearia furcata, variety?

Locality. S. Nilandu, 24 fathoms.

There is a long 200 mm. slightly branched specimen from this locality, which differs somewhat from the type. It is more delicate in build and has less prominent verrucae, and the colour is not such a pure red but tinged with orange. The spicules are of the same size and variety, but there are in proportion more double clubs.

Scirpearella indica, n. sp. Fig. 10.

Locality. S. Nilandu, 30 fathoms. W. passage of Atoll.

There are six pieces of this species in the bottle from this locality:

A, a fragment 280 mm. long, white coenenchym with prominent verrucae, red at the apex.

B, a complete specimen about 330 mm. long, verrucae not quite so prominent as in A.

C, D, E, three pieces which probably represent one complete specimen 210 mm., 70 mm. and 150 mm. in length respectively, 430 mm. in total length if they belong to the same colony.

F, a specimen which was apparently broken off and has undergone repair, 220 mm. long.

The Colour of the specimens is remarkable:

In A the coenenchym is white, but the pointed tips of the verrucae are red.

In B the verrucae are white throughout, but there are streaks of pink running irregularly along the coenenchym and uniting at the base to give the coenenchym a general pale-red colour. The other specimens are entirely white.

The only basal disc present is 12 mm. in diameter.

All the specimens are unbranched.

The diameter of the specimens varies very little and is in all about $3\frac{1}{2}$—4 mm. The apex is blunt, the base enlarges abruptly to form the disc of attachment.

The verrucae vary considerably. In A they are pointed and about 1 mm. in height, at the base of B they are broader and less prominent. In places they have an appearance like "a shallow ledge that reminds one of the edible nests of the swallow (*Callocalia*)," similar to that described by Wright and Studer for *S. profunda* (26).

The verrucae are arranged in 6 or 7 slightly spiral rows.

The only specimens of this genus that have hitherto been described were found in the Pacific Ocean. *S. profunda*, New Hebrides, 130 fathoms; *S. gracilis*, New Hebrides, 130 fathoms; *S. moniliforme*, Amboina, 100 fathoms; *S. rubra*, off Japan, 345 fathoms.

The specimens from Nilandu should be placed in a new species for which I propose the name *Scirpearella indica*.

The principal characters that distinguish the species are that the spicules rarely exceed 0·85 mm. in length and are in general smaller than they are in other species, and that the verrucae are arranged in 5—7 rows.

Order PENNATULACEA.

Family **Pennatulida.**

Pennatula murrayi, Kölliker (14).

Locality. Suvadiva, 43 fathoms. Lagoon.

Only two Pennatulids were sent to me and both of them belong to this species. The species was originally discovered by the Challenger in 129 fathoms on the S.E. coast of Ceram. It was subsequently described by Moroff[1] from the coast of Japan, and has recently been rediscovered by the Siboga in 112—397 metres in the Ceram Sea.

The species is characterised by the enlargement and modification in structure of one of the siphonozooids at the base of each of the leaves. The structure of this remarkable siphonozooid will be fully described in a subsequent paper.

The two specimens were respectively 305 mm. and 60 mm. in total length. The larger one exhibits 75 leaves on each side of the rachis, many of them being quite rudimentary, and the largest leaves are composed of eight autozooids. The smaller specimen has only 19 pairs of leaves, the largest with four autozooids.

The colour is, as in the other specimens of the species, perhaps the most delicate and beautiful of any species of Pennatulid. The terminal portion of the stalk is pink, but at the base of the lowermost leaves there is a broad band of dark-red, the rest of the rachis is pale-red. The leaves are yellow but each of the largest anthocodiae of the leaves bears a crown of red spicules.

Both of these Maldive Pennatulas are probably young ones, as was also the type specimen from Ceram.

Many of the Siboga specimens which are now in my hands for description are much larger, the largest of all being 600 mm. in total length.

[1] Th. Moroff, *Zool. Jahrbuch* XVII. 3, System.

Order ALCYONACEA.

Family **Nephthyidae.**

Eunephthya maldivensis, n. sp. Fig. 12.

Locality. Kolumadulu Atoll, between 22 and 45 fathoms.

A single specimen was obtained. It has a total height of 40 mm. with a stalk 20 mm. in length, and numerous short pointed branches. The largest anthocodiae have a width across the crown of 0·6 mm. and, varying according to the condition of their retraction, protrude 0·6—1·5 mm. from the coenenchym. The anthocodiae are not collected in bundles, but large and small are scattered evenly on all sides of the branches. The tentacles are either expanded or folded over the peristom. They are about 0·3 mm. in length in the spirit specimen, and each bears 7—9 pinnules on each side.

The spiculation of the specimen is remarkable. The surface of the stalk bears a crowd of very irregular stellate (fig. 12 *b*), rod-like and short spindle-shaped spicules, with an average length of about 0·2 mm. In the mesogloea of the stalk there are numerous stout tuberculated spindles 0·5 mm. × 0·1 mm.

On the surface of the branches the irregular spicules are wanting, but a few giant boomerang-shaped spindles are scattered about very irregularly. These large spicules have a remarkable resemblance to the spicules of the coenenchym of *Spongodes*, in shape, in the irregularity of their distribution and their great variability in size. Many spicules can be found among them which are 1·5 mm. in length, but the average length would probably be found to be about 1·2 mm. and some are less than 0·5 mm. (fig. 12 *a*).

The aboral sides of the tentacles are armed with small irregular spicules, mostly rod-shaped with long tubercular processes having a length of ·05—·1 mm., and a few of the large spicules are occasionally found on the body wall (fig. 12 *c*).

The specimen has very much the form and size of the specimen described by Kükenthal (15) from Ternate, as *Paraspongodes crassa*, but it differs from it in having the branches rather more pointed, and in some of the details of the spiculation. It has also some relation to the genus *Lemnalia* as recently described by Bourne, but differs from it in the scarcity and great size of the spicules of the coenenchym.

In a recent paper Studer (22) has given reasons for retaining the genus *Eunephthya*, and the new definition he gives of it accords more nearly with the species from the Maldives than that of any other genus.

Kükenthal[1], moreover, in his last paper also accepts the genus *Eunephthya*. According to the definition of the genus given by either of these authors the specimen clearly belongs to it. As it seems to differ, however, from any species that has yet been described I propose to call it *E. maldivensis*.

[1] W. Kükenthal, *Haeckel's Festschrift*, 1904.

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DESCRIPTION OF PLATE.

Fig. 1. Sketch to show the form of *Acanthogorgia flabellum* (n. sp.).

Fig. 2. A small portion of a branch of *Acanthogorgia flabellum* (n. sp.) to show the relative size of the old and young zooids and axis (*ax.*).

Fig. 3. A portion of a colony of *Acamptogorgia horrida* (n. sp.).

Fig. 4. One of the spicules of *Acamptogorgia horrida* (n. sp.) to show the smooth projecting spine (*sp.*) and the three foliaceous basal processes.

Fig. 5. A portion of a colony of *Elasmogorgia flexilis* (n. sp.) showing the swollen terminal knob.

Fig. 6. The terminal end of *Elasmorgia flexilis* (n. sp.) enlarged.

Fig. 7. Two of the spicules of the coenenchym of *Elasmogorgia flexilis* (n. sp.).

Fig. 8. A portion of a colony of *Scirpearia furcata* (n. sp.).

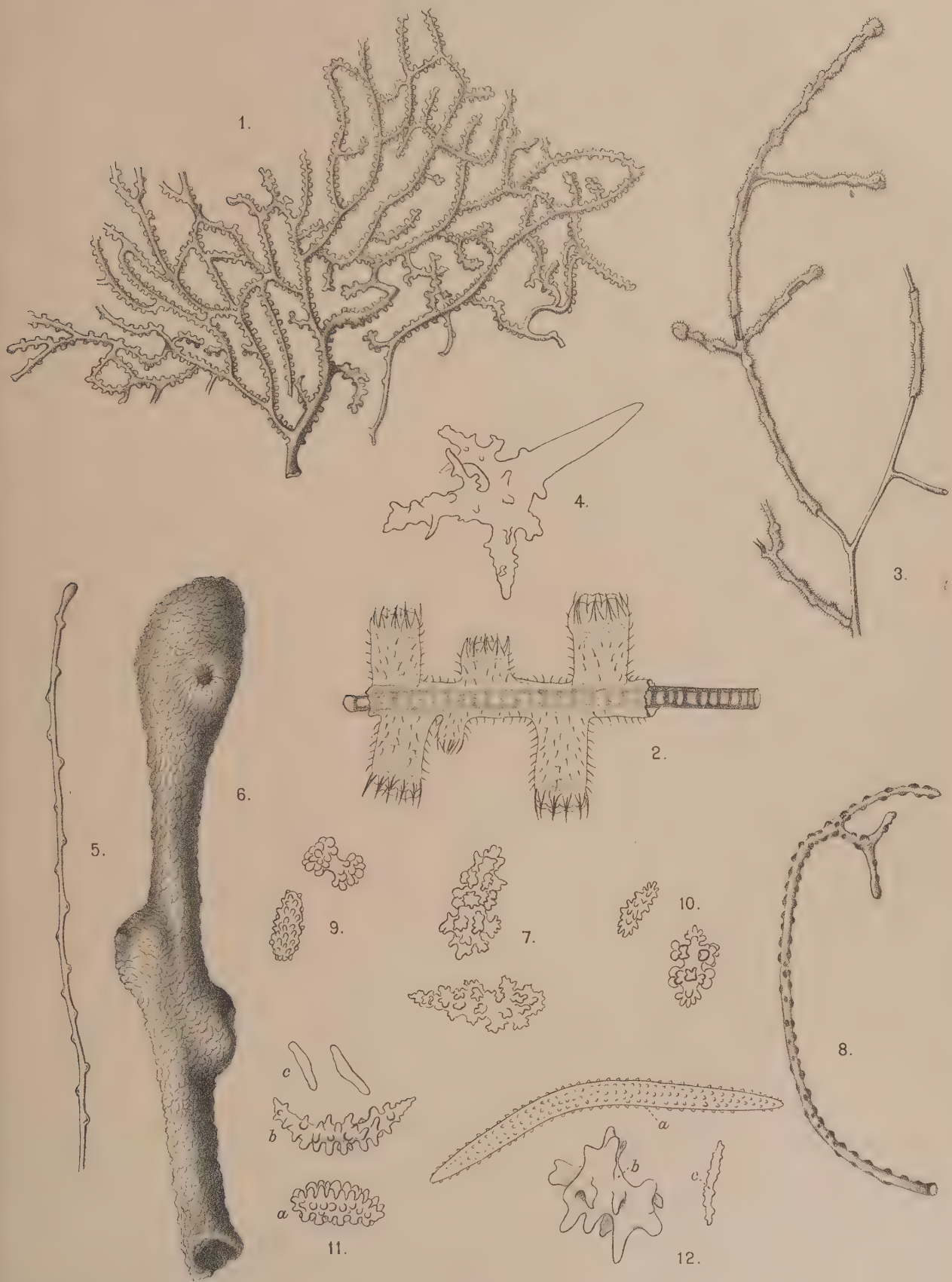
Fig. 9. Two spicules of *Scirpearia furcata* (n. sp.).

Fig. 10. Two spicules of *Scirpearella indica* (n. sp.).

Fig. 11. Spicules of *Melitodes variabilis* (n. sp.). *a*, spicule from a node; *b*, bent spindle from an internode; *c*, spicules of anthocodiae.

Fig. 12. Spicules of *Eunephthya maldivensis* (n. sp.). *a*, of the coenenchym; *b*, of the stalk; *c*, of the tentacles.

Note. *b* and *c* are more highly magnified than *a*.



E.M.D. & S.J.H. del. E. Wilson, Cambridge

HICKSON ALCYONARIA.

MARINE CRUSTACEANS.

XIV. PAGURIDAE.

By Major Alcock, F.R.S., *Director of the Indian Museum, Calcutta.*

(With Plate LXVIII.)

The collection of *Paguridae* made by Mr Stanley Gardiner in the Maldives and at Minikoi adds considerably to our knowledge, not only of the marine fauna of the islands themselves, but also of that of the northern part of the Indian Ocean; for of the 26 species and varieties obtained by Mr Gardiner no less than 9 have escaped the notice of the Indian Marine Survey-ship "Investigator" and of other Indian collectors.

From the island of Minikoi the following genera and species were obtained:

1. *Calcinus herbstii*, de Man.
2. „ *elegans*, Edw.
3. „ *gaimardii*, Edw.
4. „ *terrae-reginae*, Haswell.
5. *Diogenes gardineri*, n. sp.
6. *Pagurus fabimanus*, Dana.
7. „ (?) *scabrimanus*, Dana.
8. „ *guttatus*, Oliv.
9. „ *deformis*, Edw.

The following is the list of the collection from the Maldives:

1. *Paguristes*, sp.
2. *Clibanarius humilis*, Dana.
3. *Calcinus herbstii*, de Man.
4. „ „ var. *lividus*, Edw.
5. „ *elegans*, Edw.
6. „ *gaimardii*, Edw.
7. „ *latens*, Randall.
8. „ *terrae-reginae*, Haswell.
9. *Diogenes* sp.
10. „ „ *prox. pugilator*, Roux.
11. „ *gardineri*, n. sp.
12. *Pagurus punctulatus*, Oliv.
13. „ *fabimanus*, Dana.
14. *Pagurus* (?) *scabrimanus*, Dana.
15. „ *wood-masoni*, Alcock.
16. „ *deformis*, Edw.
17. „ *dearmatus*, Hend.
18. „ *hessii*, Miers.
19. *Eupagurus janitor*, n. sp.
20. *Nematopagurus muricatus*, Hend.
21. „ *gardineri*, n. sp.
22. *Spiropagurus spiriger*, De Haan.
23. *Anapagurus* sp.
24. *Catapagurus ensifer*, Hend.
25. *Cestopagurus olfaciens*, n. sp.

As will be seen from the foregoing lists, the *Paguridae* of the Maldives and Minikoi belong, for the most part, to species that have a wide range from the coasts of E. Africa, eastwards, far into Polynesia.

This, I may mention, is the case with the *littoral Paguridae*—and also with the *Coenobitidae*, which are *land*-hermits—of other parts of India; whereas the *sublittoral* (25—250 fathoms) genera and species inhabiting Indian seas appear to be most closely related to the sublittoral hermits of the West Indies and of the north-west coast of Africa and its outlying islands. As the sublittoral *Paguridae* are, as a whole, undoubtedly more primitive than their land and littoral relatives—as is shown by their occasional symmetry, and by the frequent persistence of paired appendages on the anterior segments of the abdomen—this correspondence is of great interest.

Subfamily **Pagurinae.**

Paguristes, Dana.

Two minute and damaged specimens from the Maldives—one from Suvadiva Atoll, the other from S. Nilandu—belong to an undescribed species of this genus. All that can be said of them is that they belong to that section of the genus which is characterized by having the rostrum obsolescent, the antennal flagellum very short, and the fingers of the chelipeds separated by a gap at base when closed, as in *P. hians*, *P. incomitatus*, and *P. jousseaumii*. From all these they are distinguished by their extremely pallid eyes.

Clibanarius, Dana.

1. *Clibanarius humilis*, Dana.

Clibanarius humilis, Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 469, Pl. XXIX. fig. 9: Heller, *Novara Crust.* p. 90.

Maldives, Goidu. One small specimen, which has been compared with one from Rarotonga.

Distribution. Laccadives and Maldives, Nicobars, Fiji Is., Tonga Is., Cook Is.

Calcinus, Dana.

2. *Calcinus herbstii*, de Man.

Calcinus herbstii, de Man, *Archiv für Naturges.* LIII. 1887, I. p. 437. *Pagurus tibicen*, Milne-Edwards, *Ann. Sci. Nat. Zool.* (2) VI. 1836, p. 278, and *Hist. Nat. Crust.* II. p. 229: *Calcinus tibicen*, Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 457: Ortmann, *Zool. Jahrb. Syst.* 1891–92, p. 292. *Pagurus laevimanus*, Randall, *Journ. Acad. Philad.* VIII. 1839, p. 135 (*fide* Dana).

Numerous specimens from Minikoi, and from Goidu, Maldives.

Distribution. Indo-Pacific from South-east and East Africa to the Sandwich Islands, but not further north or south than 30°.

3. *Calcinus herbstii*, var. *lividus*, Edw.

Pagurus lividus, Milne-Edwards, *Ann. Sci. Nat. Zool.* (3) x. 1848, p. 63. *Calcinus herbsti*, var. *lividus*, Borradaile, *P.Z.S.* 1898, p. 462.

A single specimen from Goidu, Maldives.

4. *Calcinus elegans*, Edw.

Pagurus elegans, Milne-Edwards, *Ann. Sci. Nat. Zool.* (2) VI. 1836, p. 278, Pl. XIII. fig. 2, and *Hist. Nat. Crust.* II. p. 229. *Calcinus elegans*, Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 458, Pl. XXVIII. fig. 10 *a—c*: Ortmann, *Zool. Jahrb. Syst.* VI. 1891–92, p. 294. *Pagurus pictus*, Owen, *Zool. H.M.S. Blossom*, 1839, *Crust.* p. 83, Pl. XXV. fig. 2. *Pagurus decorus*, Randall, *Journ. Acad. Philad.* 1839, p. 134.

Two specimens from Manadu, Addu, Maldives; one from Minikoi.

Distribution. Indo-Pacific, from S.E. Africa to the Sandwich Is., but not much north or south of the tropics. Miers also mentions, but I cannot discover his authority, Pacific coast of Patagonia.

5. *Calcinus gaimardii*, Edw., Dana.

Pagurus gaimardii, Milne-Edwards, *Ann. Sci. Nat. Zool.* (3) x. 1848, p. 63. *Calcinus gaimardii*, Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 457, Pl. XXVIII. fig. 9: Ortmann, *Zool. Jahrb. Syst.* VI. 1891–92, p. 294.

Two specimens from Hulule, Male, Maldives; one from Minikoi.

Distribution. Islands of the Indo-Pacific from Minikoi and the Maldives to Tahiti (Minikoi, Maldives, Nicobars, Amboina, Balabac Str. and Sulu Sea, Liu Kiu and Ohosima, Funafuti, Rotuma, Fiji, Tahiti).

6. *Calcinus latens*, Randall, Dana.

Pagurus latens, Randall, *Journ. Acad. Philad.* 1839, p. 135 (*fide* Dana). *Calcinus latens*, Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 459, Pl. XXVIII. fig. 11: Ortmann, *Zool. Jahrb. Syst.* VI. 1891–92, p. 293. *Calcinus intermedius*, de Man, *Notes Leyden Mus.* III. 1888, p. 102 (*vide* de Man, *Notes Leyden Mus.* XIII. 1891, p. 58).

One specimen from Hulule, Male, Maldives.

Distribution. From the Red Sea and E. coast of Africa to the Sandwich Is., not outside 27° N. or 34° S.

7. *Calcinus terrae-reginae*, Haswell.

Calcinus terrae-reginae, Haswell, *P.L.S. N.S.W.* VI. 1881–82, p. 760, and *Cat. Austral. Crust.* p. 158: de Man, *Archiv f. Naturges.* LIII. 1887, I. p. 439, and *Journ. Linn. Soc. Zool.* XXII. 1888, p. 226.

This species, which is probably only a variety of *C. latens*, Randall, seems to be common at Minikoi and the Maldives. Numerous specimens from Minikoi, and from Goidu, Hulule, Male, and Fadifolu, Maldives.

Distribution. Indian Seas, Malay Archipelago, Queensland.

Diogenes, Dana.

Three small species are represented in the collection. One of them is nearly related to *D. pallescens* Whitelegge, from Funafuti, and is here described as a new species. Another may perhaps be the young of *D. pugilator* Roux, a Mediterranean and Atlantic species which is also found in the Red Sea and, according to Nobili, at Singapore. The third form seems to be new, but it cannot be satisfactorily characterized from a single minute and damaged specimen.

8. *Diogenes gardineri*, n. sp. Plate LXVIII. fig. 1.

The rostrum is a simple spinule, and both the chelipeds are pilose.

Carapace elongate, nearly smooth, its antero-lateral borders finely serrulate. "Rostrum" a slender spinule slightly longer than the ophthalmic scales.

Eyestalks remarkably long, considerably longer than the anterior border of the carapace, almost as long as the peduncle of the antennule and very much longer than that of the antenna. Ophthalmic scales spinulose at the antero-internal angle.

Peduncle of the antenna remarkably short, barely reaching to the base of the terminal joint of that of the antennule. Antennal acicle a serrated spinule not surpassing the penultimate joint of the peduncle.

Chelipeds pilose. Left cheliped much the larger: when denuded its outer surface is smooth except for a longitudinal series of three or four spines on the outer surface of the carpus: the upper border of the merus is serrulate, and the lower outer border of the merus and the inner and anterior borders of the wrist and the upper border of the palm are spinulose: the outer surface of the palm is traversed by a longitudinal bulge, or low carina, the summit of which is finely granulous.

The 2nd and 3rd legs reach, or slightly surpass, the end of the left cheliped: they are setose and, except for a spinule at the far end of the anterior border of the carpus, smooth: the dactyli are longer than the propodites.

Length of carapace about 4 mm.

In the shell of a small species of *Cerithium*.

Mahlos, Maldives, 23 fathoms; Minikoi.

In the remarkable length of the eyestalk and the abbreviated antennal peduncle, this species resembles *D. pallescens* Whitelegge, from Funafuti.

Pagurus, Fabr.

9. *Pagurus punctulatus*, Olivier.

Cancer megistos, Herbst, *Krabben u. Krebse*, III. iv. p. 23, Pl. LXI. fig. 1, 1804. *Pagurus punctulatus*, Olivier, *Encycl. Méthod.* VIII. p. 641, 1811: Quoy et Gaimard, *Voy. Uranie et Physicienne*, p. 528, Pl. LXXVIII. fig. 2: Milne-Edwards, *Hist. Nat. Crust.* II. p. 222: Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 451, Pl. XXVIII. fig. 4 *a*, *b*: Ortmann, *Zool. Jahrb. Syst. etc.* VI. 1891, p. 286 (distrib.).

Two specimens from the Maldives, Hulule, Male Atoll. One of them is a giant, with a cephalothorax 70 mm. ($2\frac{4}{5}$ inches) long, and is lodged in a large shell of *Dolium* with several small sea-anemones attached.

Distribution. This common species ranges from the Red Sea and East coast of Africa eastwards as far as the Sandwich Is., and southwards as far as Australia; that is to say, from about 40° E. to about 150° W., and from about 28° N. to about 30° S.

10. *Pagurus fabimanus*, Dana.

Pagurus fabimanus, Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 454, Pl. XXVIII. fig. 7 *a—e*, 1852: Hilgendorf, *MB. k. Akad. Berlin*, 1878, p. 819: Whitelegge, *Mem. III. Austral. Mus.* 1897, p. 142.

The numerous small specimens that I identify with this species I was at first inclined to regard as young of a variety of *P. sculptipes* Stimpson until I had seen the undoubted young of the latter species. They agree perfectly well with Dana's description and figures except that the dactylus of the left cheliped is less distinctly (more minutely) spinulose than Dana's fig. 7 *b*.

Four specimens from the Maldives, Hulule, Male Atoll, and seven from Miladumadulu Atoll: 15 from Minikoi.

Distribution. East coast of Africa (Ibo), Maldives and Minikoi, Philippines, Fiji, Tongatabu, Funafuti.

11. ?*Pagurus scabrimanus*, Dana.

Pagurus scabrimanus, Dana, *U.S. Expl. Exp. Crust.* Pt I. p. 455, Pl. XXVIII. fig. 8 *a—c*, 1852: ?de Man, *Notes Leyden Mus.* III. 1881, p. 100.

Two small specimens very closely resembling *P. fabimanus*, but differing therefrom in the shorter eyestalks, larger eyes, and different form and sculpture of the two terminal joints of the 3rd left leg, are doubtfully referred to this species.

One is from Minikoi, the other from the Maldives.

Distribution. Philippines, ?Red Sea, ?Minikoi and Maldives.

12. *Pagurus wood-masoni*, n. sp.

A diagnosis and figure of this species is about to be published in the Indian Museum Catalogue of Crustacea Anomura.

The eyestalks reach beyond the end of the antennular peduncle, but the eyes are large, occupying between a third and a fourth the length of the terminal joint of the eyestalk. Though the carapace is depressed, its length in the middle line exceeds its greatest breadth. The legs and chelipeds are strongly spinulose, but only sparsely setose. The left cheliped is vastly larger than the right, and when its joints are fully extended the hand is strongly inclined inwards—a diagnostic character that excludes all other *Paguri*.

A single small specimen from the Maldives.

Distribution. Andamans and Maldives.

13. *Pagurus guttatus*, Oliv., de Man.

Pagurus guttatus, Olivier, *Encycl. Méth.* VIII. 1811, p. 640: Quoy et Gaimard, *Voy. Uranie*, p. 533, Pl. LXXIX. fig. 3: Milne-Edwards, *Hist. Nat. Crust.* II. 223: Dana, *U.S. Expl. Exp.*

Crust. Pt I. p. 451, Pl. XXVIII. fig. 3 *a*, *b*: de Man, *Abh. senckenberg. Nat. Ges.* XXV. 1902, III. p. 738 (*ubi synon.*). *Pagurus setifer*, Hess, *Archiv für Nat.* XXXI. 1865, p. 161: Hilgendorf, *MB. k. Ak. Berlin*, 1878, p. 815, Pl. III. fig. 8: Ortmann, *Zool. Jahrb. Syst.* VI. 1891, p. 287: Borradaile, *P.Z.S.* 1898, p. 460, and Stom. and Macr. Willey's *Exp.* p. 425.

De Man (*l.c.*) adequately confirms Henderson's decision—questioned by Ortmann—that the name *P. setifer* cannot be applied to this species.

Two specimens from Minikoi.

Distribution. From E. Africa (Mozambique) eastwards as far as 180° E., its northerly limit about 8° N., its southerly limit about 34° S.

14. *Pagurus deformis*, Edw.

Pagurus deformis, Milne-Edwards, *Ann. Sci. Nat. Zool.* (2) VI. 1836, p. 272, and *Hist. Nat. Crust.* II. p. 222: Miers, *Zool. H.M.Ss. Erebus and Terror, Crust.* p. 3, Pl. II. fig. 3: Hilgendorf, *SB. Ges. Nat. Freunde, Berlin*, p. 1878, p. 186 (hermaphroditism): Ortmann, *Zool. Jahrb. Syst.* VI. 1891, p. 288 (distrib.). *Pagurus cavipes*, White, *P.Z.S.* 1847, p. 122. *Pagurus cultratus*, White, *List Crust. Brit. Mus.* p. 60, 1848 (*fide* Miers).

Maldives, Hulule, Male, 3 specimens; Manadu, Addu, 2 specimens; Laccadives, Minikoi, 1.

Distribution. From the east coast of Africa eastwards to about 150° W., with northern limit about 28° N. (Liu Kiu Is.) and southern limit about 18° S.

15. *Pagurus dearmatus*, Henderson.

Pagurus dearmatus, Henderson, *Challenger Anomura*, p. 58, 1888, and *Journ. As. Soc. Beng.* LXV. 1896, Pt II. p. 518.

Maldives, Haddumati 1, Mahlos 1.

Distribution. Maldives, Ceylon, Admiralty Is.

16. *Pagurus hessii*, Miers.

Pagurus hessii, Miers, *Zool. H.M.S. Alert*, pp. 185, 264, Pl. XXVIII. fig. A, 1884: Henderson, *Trans. Linn. Soc. Zool.* (2) V. 1893, p. 419 (*syn.*). *Pagurus similimanus*, Henderson, *Challenger Anomura*, p. 59, Pl. VI. fig. 6, 1888.

This is the only *Pagurus* in which the chelipeds and crawling-legs on both sides are quite identical in length, form, and sculpture.

Maldives, 1 broken specimen.

Distribution. Maldives, Bay of Bengal and Gulf of Martaban, 13 to 35 fathoms; Penang, Celebes Sea, 10 fathoms; Arafura Sea, 32 to 36 fathoms.

Subfamily **Eupagurinae.**

Eupagurus, Brandt.

Only one species of this cosmopolitan genus is represented in the collection, and is new to science.

17. *Eupagurus janitor*, n. sp. Plate LXVIII. figs. 2 and 4.

Closely related to *E. hirtimanus*, White.

As in *Pylopagurus* the enlarged right hand is deflexed at an angle with the wrist to form a door to the shell inhabited (a species of *Turbo*); and somewhat as in *Cancellus* the 2nd and 3rd pairs of legs support the door though they are not specially modified for the purpose.

Carapace bearing some tufts of setae, three tufts in a line on either side of the gastric region being conspicuous. Rostrum broadly triangular, but acute, much more prominent than the ill-defined antennal angles of the carapace.

Eyestalks almost piriform, much shorter than the anterior border of the carapace, reaching into the distal third of the terminal joint of the antennular peduncle, and into the distal half of the same joint of the antennal peduncle. Eyes subreniform, very large and black. Ophthalmic scales distant, narrow, foliaceous, dorsally concave.

Antennal peduncle decidedly larger than antennular peduncle, setose at base: acicle curved, setose, overlapping base of terminal joint of peduncle: flagellum nearly twice as long as the carapace, nude.

Chelipeds both tomentose and hairy, but not so as to entirely conceal surface sculpture; legs hairy.

Right cheliped vastly more massive than the left, short and stout, the hand permanently deflexed almost at right angles with the wrist: merus pyramidal, smooth and polished: carpus triangular, as long as merus and broader than long; there are 2 or 3 claw-like spines at the far end of its upper border, 3 or 4 spines in a longitudinal row on its upper surface, and a short irregular median series of granules on the same surface: the palm is longer and much broader than the wrist and much broader than long; its outer edge forms, with that of the fixed finger, a curve of about 120°, and its inner edge, with that of the dactylus, is almost straight, both edges being thickly setose and very regularly serrated; its extensor surface, when denuded, is found to be studded with granules, of which a few here and there are enlarged: the dactylus is much narrower than the fixed finger and has a median longitudinal row of pearly granules on its upper surface; the finger tips are calcareous.

The slender left cheliped reaches the base of the right dactylus: the lower border of its merus is spinulose, and the upper surface of its carpus carries two longitudinal rows of spines: the palm is about as long as the fingers, which are blunt and spooned.

The 2nd and 3rd legs slightly exceed the larger cheliped, those of the right side being the longer: their three distal joints are not capable of complete extension in a straight line with the merus and are carried, much as in *Cancellus*, almost at right angles with the merus, so that those of the right side are closely applied to the convex outer border of the deflexed hand. The legs are stout and beset with bristles: the dactyli end in sharp black claws, the dactylus of the 3rd pair being as long as, that of the second pair being shorter than, its propodite.

The male has 4 abdominal appendages on the right side.

Colours in spirit: eyestalks, chelipeds and legs, reddish-yellow.

Length of carapace of male nearly 12 mm.: a female with eggs is smaller.

Maldives, Hulule, Male Atoll, one male and one female.

In *Eupagurus operculatus*, Stimpson, from the Florida reefs the right hand forms an operculum as in *E. janitor*, but the two species do not seem to be otherwise alike.

Nematopagurus, Edw. and Bouv.

This genus resembles *Eupagurus* on the one hand and *Catapagurus* on the other, but differs from both in the rather remarkable character—a character shared also by *Pylopagurus*, *Pylopaguropsis*, and *Munidopagurus*—that the female only (not the male) has a pair of appendages, modified for sexual purposes, on the first abdominal segment.

It agrees with *Catapagurus* in having the vas deferens of the right side protruded, but the protruded tube ends in a long slender filament: moreover the left vas deferens also protrudes, though it forms only a short conical tube.

Five species of *Nematopagurus* are found in the seas of India, mostly in the sublittoral depths; the only other species known is *Nematopagurus longicornis*, Edw. and Bouv., from depths of about 42 to about 1410 fathoms of the Eastern Atlantic (from the North of Spain to Cape Verde) and the Western Mediterranean. It is a remarkable fact—one of many similar facts of distribution that will be discussed in a forthcoming volume on the Indian *Paguridae*—that this Atlantic and Mediterranean species differs in only a few trifling particulars from a species found at 102 fathoms in the Arabian Sea.

18. *Nematopagurus muricatus*, Henderson.

Catapagurus muricatus, Henderson, *Journ. Asiatic Soc. Bengal*, LXV. Pt II. 1896, p. 524.

Illustrations of the Zool. of the Investigator, *Crust.* Pl. XXXI. fig. 3.

Two males and a female from the Maldives.

Distribution. Maldives; off N.E. and S. coasts of Ceylon, 28—34 fathoms.

19. *Nematopagurus gardineri*, n. sp. Pl. LXVIII. fig. 3.

Resembles *N. indicus*, but has much longer eyestalks and more pilose chelipeds.

Carapace smooth, rostrum indistinct. Eyestalks as long as the anterior border of the carapace, longer than the antennal peduncles, and reaching to the distal fourth of the terminal joint of the antennular peduncles. Eyes not much expanded: ophthalmic scales very small, bifid at tip. Antennal acicle curved, setose, nearly reaching the end of the peduncle: flagellum long, nude.

Chelipeds thickly pilose, especially so on the outer surface of the wrist and palm; the right is a little larger than the left, but both are almost alike in form and sculpture: the carpus has an iridescent sheen, its inner edge is spinose, and there is a median longitudinal row of spines on its outer surface: both edges of the palm are well defined and serrulate, and there is a median longitudinal carina on the outer surface of the palm: the palm is slightly longer than broad, longer than the fingers in the right cheliped, and about as long as the fingers in the left.

Second and 3rd legs nearly a dactylus longer than the chelipeds: they are sparsely setose and except for a spine at the far end of the anterior border of the carpus are unarmed: the dactyli end in a sharp claw and have some capillary spinelets on their posterior border: the dactylus of the 3rd pair is about as long as the combined merus and carpus.

The paired appendages of the first abdominal somite of the female are slender, curved rods.

Length of carapace of an egg-laden female, 5 mm.

A single specimen, inhabiting a shell of a Cerithiid, from the Maldive Is.

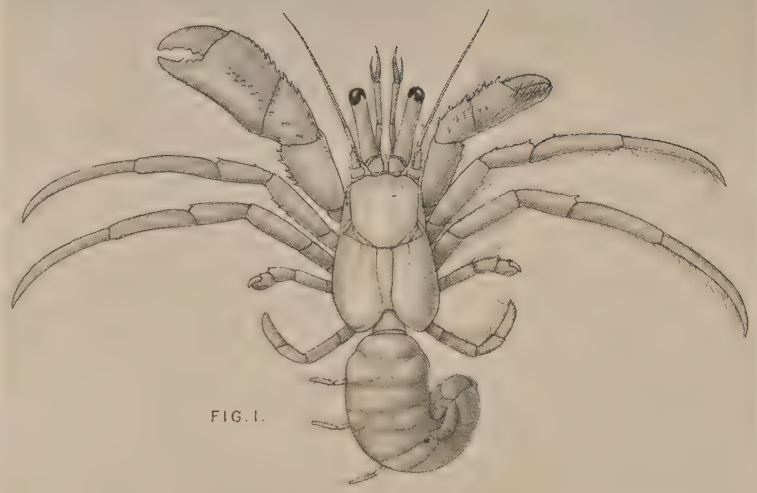


FIG. 1.

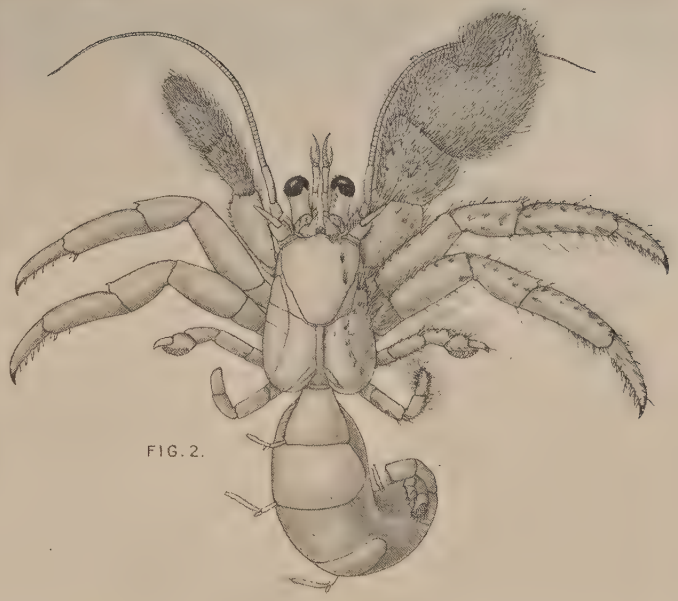


FIG. 2.

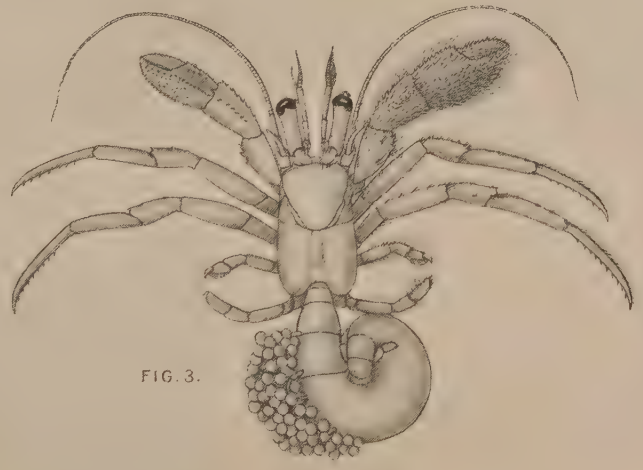


FIG. 3.

FIG. 4.

Spiropagurus, Stimpson.

20. *Spiropagurus spiriger*, De Haan.

Pagurus spiriger, De Haan, *Faun. Japon. Crust.* p. 206, Pl. XLIX. fig. 2. *Spiropagurus spiriger*, Stimpson, *Proc. Acad. Nat. Sci. Philad.* (1858) 1859, p. 248: Henderson, *Challenger Anomura*, p. 72: Ortmann, *Zool. Jahrb. Syst.* VI. 1891—92, p. 297.

Several small specimens from the Maldives.

Distribution. Japanese and Chinese Seas, to 16 fathoms: Seas of the East Indian Archipelago, to 49 fathoms: Bay of Bengal, to 30 fathoms: Maldives.

The adult animal seems to love light shells like those of *Pirula*.

Anapagurus, Henderson.

21. *Anapagurus*, sp.

A small specimen *minus* most of its appendages, from the Maldive Is., is perhaps referable to this genus.

Catapagurus, A. M.-Edw.

22. *Catapagurus ensifer*, Henderson, *Trans. Linn. Soc. Zool.* (2) v. 1893, p. 424, Pl. XXXVIII. figs. 16—19.

Numerous specimens, males and egg-laden females, from the Maldives. Some with a commensal sea-anemone.

Distribution. Gulf of Martaban, Maldives.

Cestopagurus, Bouvier.

23. *Cestopagurus olfaciens*, n. sp.

Rostrum fairly prominent. Eyestalks longer than the anterior border of the carapace and than the antennal peduncles, but much shorter than the antennular peduncles. These last are particularly long and stout, their terminal joint is club-shaped, and their upper flagellum is divided into about 9 segments (not including the terminal filament), each of which carries a bunch of hairs that is longer and more conspicuous than the lower flagellum.

The right cheliped is very much larger than the left, and is smooth and almost bare: the hand is the biggest joint, and the palm is longer than broad, and broader at its far end than at its near end.

The 2nd and 3rd legs are smooth and bare, the dactyli being long and very slender.

The right vas deferens passes from the coxa of the 5th right leg across the *ventral* surface of the abdomen, and then ascends obliquely over the *left* flank: it increases slightly in calibre distally, and ends abruptly.

The length of a carapace of a male is 3 mm., of an egg-laden female 2 mm. In two males the left gill-chamber is greatly distended by a parasite.

N. Male Atoll, Maldive Is. Several specimens, in tiny shells of various kinds, chiefly long turret-shells.

This species differs from *C. coutieri* in its very long antennules, its remarkably long and stout olfactory hairs, its smooth and bare chelipeds, its abruptly-ending vas deferens, and its long and slender dactyli of the 2nd and 3rd legs.

PLATE LXVIII.

FIG. 1. *Diogenes gardineri* n. sp. × 6.
FIG. 2. *Eupagurus janitor* n. sp. × 2.
FIG. 3. *Nematopagurus gardineri* n. sp. × 4.
FIG. 4. *Eupagurus janitor* n. sp. × 2.

HYDROIDS.

By L. A. Borradaile, M.A., *Lecturer in Natural Sciences at Selwyn College, Cambridge.*

(With Plate LXIX.)

I.

Three-and-twenty species of Hydroid Zoophytes were brought back from the Maldive Islands by Mr Stanley Gardiner's expedition. Such a collection must at least have been worth considering from the faunistic standpoint, but, as it happens, this is not the only way in which the specimens have repaid examination. Some words at the outset on the points of interest in the collection will therefore not be amiss.

1. Two new facts are of some morphological importance as bearing on the relation of the gonotheca to the hydrotheca, and therefore on that of the blastostyle to the ordinary polyp.

There is in the collection a specimen of *Lictorella halecoides* carrying its gonothecae, which have hitherto been unknown. These gonothecae are remarkable by being in every way like the hydrothecae save that they do not take part in the regular arrangement of the latter and are nearly four times their size. Furthermore, though they do not, in the specimen, contain gonophores, there is at the bottom of each of them a hydranth, perfectly formed and to all seeming exactly like those in the hydrothecae except for its greater size[1]. Indeed the suggestion arises that they may be giant hydrothecae and no more. But the impression that they make is undoubtedly that of gonothecae, there seems no other reason why giant hydrothecae should be found, and a strong argument for their having a gonidial function is found in the fact that the blastostyles of another Campanularian, *Halecium halecinum*, also carry hydranths at the end (**2**, p. 58). In that case, it is true, there are *two* hydranths to the blastostyle, but meristic repetition will probably account for this. The ripe gonotheca of *L. scandens*, though it is less hydrotheca-like than the present structure, is enough so to bridge over the gap towards more specialised gonothecae, and it is particularly interesting to notice that, according to Bale, its blastostyle has an open mouth (**8**, p. 759).

The meaning of these facts is clear. There can now be no doubt, as indeed there was little before, that the blastostyle is a modified hydranth, and the gonotheca a modified hydrotheca.

But while one species in the collection gives clear information on this point, there is another which would seem to raise the whole question anew. A *Synthecium* (*S. maldivense*) found in several of the atolls has gonothecae of the kind which characterise the genus. That

[1] The ordinary hydranths are not well preserved.

is to say they arise *from within* perfectly normal hydrothecae, placed in a row with the others, but containing no hydranths. What is the meaning of this? Whether there were ever a hydranth in the hydrotheca or not it is as yet impossible to say, though it is known that hydranths may die and be replaced, but at present the presumption must be that there was, and that its place has been taken by the blastostyle. The question is rather what may be the relation of the latter to the former[1]. Two things suggest themselves. Either the blastostyle may be an outshoot of the hydranth comparable to the gonophore-stalk of *Tubularia*, or it may be equivalent to the hydranth, and thus show a normal case of the same process which leads to the occasional replacement of one of the limbs of an arthropod by a limb of a kind found in another part of the body (**9**). There are, however, some considerations which make the latter of these two cases the more likely. If the blastostyle were an outshoot of the hydranth there would be no more reason for its having a theca than for a tentacle to be so covered. Again, in *Thecocladium* the same replacement of a hydranth by another member of the body takes place, only here it is a branch that grows out of the hydrotheca (**6**, II. p. 80). But the strongest witness to the unlikelihood of the gonophore-stalk suggestion is borne by the present new species of *Synthecium* in which, besides the gonothecae which arise from within hydrothecae, there are others growing from the stem between and among them. It is far more likely that these are homologous with the scattered gonothecae of other Campanularians, which we have traced through *Halecium* and *Lictorella* to whole hydranths, than that they represent gonophore-stalks borne formerly on the body of hydranths that have now disappeared, or were perhaps never developed when the stalks became scattered outside the hydrothecae.

2. Faunistic conclusions are hard to draw from a collection of Hydroids, and that for two reasons—the tendency in the group towards wide distribution, and the scantiness of our knowledge. At the same time there are undoubtedly strong distinctions between the faunas of certain localities, as for instance between that of the north of Australia and either that of the south of the same continent on the one hand, or that of Britain, for instance, on the other. It is therefore possible to discuss the affinities of any given locality to others, even though general conclusions as to the nature and limits of the regions have not as yet been reached.

No Hydroids were brought back from Minikoi, but the general character of its fauna in that group is, no doubt, well enough shown by the Maldive collection. This contains, as has been said, specimens of 23 species, of which 7 are identical with, or closely related to, North Australian forms, 5 to South Australian, 3 to New British, 3 to West Indian, 2 to North-east Atlantic, and 1 to a Cinghalese species[2]. Thus the greatest likeness, so far as numbers show, is to the North Australian fauna. At the same time, in view of the very much smaller number of species known from New Britain (eight), the fact that as many as three in the far from large Maldive collection are also found in the former locality is very striking, especially as they have not hitherto been recorded elsewhere. Another interesting feature of the collection is that it shows nearly as much kinship to the fauna of the south of Australia as to that of the north, though these are very distinct from one another (**6**, **7**). The finding of North-east Atlantic and of West Indian forms is not so noteworthy as it would be in a group with less tendency to the wide distribution of its species,

[1] Whether it were ever actually present or not.

[2] Some of the species are new and not closely akin to any already known. Others are recorded from more than one part of the world.

and that only one species is known to be closely akin to one from Ceylon is probably due to our very small knowledge of the Hydroid fauna of that island.

A *Campanularia* which was hitherto only known to grow on the back of a turtle has now been found on coral, and a new species was taken on a sea-snake.

3. As usual, variability has given much trouble from the systematic point of view, making hard to settle both the limits of species in the collection, and also the identity of some of them with forms already described. There is indeed but one of these to which I have applied established names which is not in some way unlike its type. This is, I think, an example of that connection of variation with location to which I have already called attention in reporting on the crabs of the genus *Pilumnus* brought home by the expedition (**11**, pp. 195 and 244), and to which I have there restricted the use of the word "subspecies[1]." Of the presence of "varieties" in the sense in which I have used the word in dealing with the Crustaceans I find no clear evidence among the Hydroids, though I suspect that some, at least, of the forms I have described as new species owe their origin to it.

4. In the systematic part of the paper I have adopted Schneider's classification (**17**) with the modifications made in it by Bonnevie (**10**), and some small alterations of my own. It will be seen that nine of the forms—about three-eighths of the whole number—show such differences from those already known that they must become new species. All but one of the rest, as I have already said, differ from those nearest to them in ways which do not entitle them to more than subspecific rank. The *corbula* of *Aglaophenia delicatula* is described for the first time.

II.

The following list sets forth the forms collected by the expedition, with particulars as to their distinguishing characteristics, and notes on other points of interest.

Order Gymnoblastea.

Family **Tubularidae.** Genus *Tubularia.*

1. *Tubularia pacifica* (Thornely) subsp. (**16**, p. 452).

The tentacles of the outer ring in my specimens are shorter than in Miss Thornely's, being only about one-third longer than the body when the latter is at full length. The height of the polyp is also less, being only 1 cm. instead of 2 cm. as in Miss Thornely's specimen.

Dredged in Suvadiva Atoll in 37 fathoms of water.

Family **Eudendriidae.** Genus *Eudendrium.*

2. *Eudendrium maldivense* n. sp. (Pl. LXIX. fig. 1.)

Definition: An *Eudendrium* whose hydrocaulus reaches a height of 4 cm., is not fascicled, and has a fairly stout main stem that sometimes gives off only short, weak, alternate branches

[1] As to how far it be due to "vegetative" variation (**13**, p. 755) and how far to the piling up of "normal" variations by selection, which is, I believe, the cause of origin of subspecies in the crustacea, there is no evidence.

which bear one to four hydranths each, but sometimes also breaks subdichotomously into stout limbs. The branches and the stalks of the hydranths start with some ill-marked rings. The male gonophores are bithalamic, one or a few springing from the body of a hydranth. The female gonophores are egg-shaped and grow in a cluster on a tentacleless hydranth.

This species is akin to *E. gracile* Allm., from the West-Indian region (**5**, p. 7).

Dredged in South Nilandu, Kolumadulu, and Mahlos Atolls, in 30, 24, and 22 fathoms respectively.

Order Calyptoblastea.

Family **Campanularidae.** Subfamily **Campanularinae.**

Genus *Campanularia.*

3. *Campanularia serrulatella* n. nom. subsp.

Obelia serrulata Thornely (**16**, p. 453).

My specimens differ from Miss Thornely's only in two small points: (1) The teeth on the rim of the hydrotheca are sharper. (2) The floor is rather nearer the bottom of the cup. Of the two hydrothecae figured by Miss Thornely the right-hand one is more like mine in having slightly curved sides.

I do not regard this species as the *Campanularia serrulata* of Bale (**8**, p. 757), from which it differs considerably in the shape of the hydrothecae and in the mode of growth, which is tree-like, with irregularly dichotomous branching. It has therefore been necessary for me to give it a new name.

Dredged in Mulaku, Addu, and Suvadiva Atolls in 30, 25, and 42 fathoms respectively.

4. *Campanularia linearis* (Thornely) subsp. (**16**, p. 453).

My specimens differ from Miss Thornely's in two points only. (1) The longitudinal lines on the hydrothecae, which she found "usually," and thought to be owing to the collapsing of their delicate sides, are in mine always seen at the base of the teeth, from which they reach about one-third of the way down the cup, and are due to ridges. (2) The teeth are very sharp, not "blunted."

Dredged in Suvadiva Atoll in 20 and 37 fathoms, and in N. Male in 27. The N. Male specimens are smaller and more branched than those from Suvadiva.

5. *Campanularia cheloniae* Allm. subsp. (**6**, II. p. 22).

In my specimens the hydrothecae are somewhat wider than in the type. They were dredged in N. Male Atoll in 25 fathoms, on coral. Allman's were from the back of a turtle in an unknown locality.

6. *Campanularia junceoides* n. sp. (Pl. LXIX. fig. 2.)

Definition: A *Campanularia* whose hydrocaulus consists of strong stems with few branches and rare nodes, arising in a cluster from a branched hydrorhiza, and carrying large, narrow, deep, alternate hydrothecae set on brackets, from which they are not marked off by a joint but by a short, narrow stalk. The height is not more than 5 cm. in any of my specimens.

This species is near to *C. juncea* Allm. from Ceylon (**4**, p. 260), but differs in the rarity of the nodes, in the absence of a joint between the hydrotheca-stalk and its bracket, and in the smaller height.

Taken on the reef at Hulule, Male Atoll, and Goidu, Goifurfehendu Atoll, and dredged in Kolumadulu, N. Male, and S. Nilandu Atolls in 20—25 fathoms.

7. *Campanularia* sp.

The body of a black and white sea snake from Male is covered in the middle half of its length with a thick growth of a hydroid. Unfortunately the preservation of this hydroid is very bad, perhaps because it was already dead when the snake was caught. There is a branched, creeping hydrorhiza on the scales of the snake, which were being shed and bringing the growth away with them. From this arise many hydrocaulus stems. Primary branches come off irregularly on all sides of the main stem, and themselves bear secondary branches. On the stem and on the branches of both orders are shorter twigs with wavy walls. These twigs bear the hydranths, but the latter are in such a state of preservation that nothing can be certainly made out in them. There are, however, some indications of a delicate hydrotheca, and on this account I have placed the specimen here. Both branches and twigs are directed upwards at a sharp angle with the stem.

This partnership recalls the case of a small fish found by Alcock to be covered by a *Stylactis* (**1**). In the present instance, however, it would seem that the advantage must be all on the side of the hydroid, if indeed either party derive any benefit from the association. It is at least difficult to imagine a sea snake wanting any weapon but its own fangs.

Subfamily **Lafoeinae.** Genus *Lictorella.*

Schneider is, I think, wrong in uniting this genus with *Lafoea.* It differs not only in having a floor to the hydrotheca but in far more important points connected with the gonothecae, which arise from the same tube of the hydrocaulus as the hydrothecae, are like the latter in shape, and are scattered, and not clustered into a *coppinia* or *scapus.*

8. *Lictorella halecoides* (Allm.) subsp. (**3**, p. 472; **6**, II. p. 35). (Pl. LXIX. fig. 3.)

The specimens differ from Allman's in two ways: (1) the side branches are not themselves branched. This, however, may depend on the smaller size of the colony. (2) The ends of the branches are divided into internodes, but only some of the hydrothecae have jointed stalks. The branches are pinnately arranged as in *L. cyathifera* Allm. and the Shetland specimens of *L. halecoides,* and not irregularly as in the Cape York specimens. The shape of the hydrothecae, though it is not so constant as in Allman's figures, is in some cases absolutely the same as in that author's specimens. I much doubt the distinctness of this species from *L. cyathifera* (**6**, II. p. 36).

The gonothecae have already been described in this paper (p. 836).

Dredged in Kolumadulu and N. Male Atolls in 24 and 20 fathoms respectively.

9. *Lictorella scandens* (Bale) subsp. (**8**, p. 758).

This species must be removed from *Lafoea,* where Bale placed it, and stand here on account of the characters which I have mentioned above. The present specimen differs from Bale's type in having no joint in the stalk of the hydrotheca. It was found as an overgrowth on *Synthecium tubiger* dredged in N. Male Atoll from a depth of 20 fathoms.

Family **Sertularidae.** Genus *Synthecium.*

10. *Synthecium tubiger* n. sp. (Pl. LXIX. fig. 4.)

Definition: A *Synthecium* whose hydrocaulus reaches a height of more than 4 cm. and is pinnate, with rather distant, opposite pinnae, and nodes often obsolete or lost. The distance between the hydrothecae varies; they are usually opposite, but sometimes alternate in parts of the pinnae, tubular, with a rather long free portion, which is bent sharply outwards, and have circular openings, directed outwards, with entire, everted rims often more than one in number. The gonothecae are egg-shaped, but pointed at the free end, and quite simple in outline.

The species is kindred to *S. orthogonia* (Busk) but differs from it in the shape of the gonothecae and in the loss of the nodes. (**12**, p. 390; **8**, p. 767.)

Taken in many dredgings throughout the Archipelago in 20—40 fathoms.

11. *Synthecium maldivense* n. sp. (Pl. LXIX. fig. 5.)

Definition: A *Synthecium* whose hydrocaulus reaches 20 cm. in height and is pinnate, the pinnae being alternate and having each a hydrotheca in its axil; whose hydrothecae are borne on the stem as well as on the pinnae, often grouped in sets of two or three pairs as an internode but at other times at even distances, opposite or alternate, long in shape, adnate for the greater part of their length to the stem but not to one another, with the outstanding part curved at right angles to the adnate part and varying in length though always short, and have a vertical opening overhung by a membranous hood and often stronger at the sides so as to give the impression of a pair of side teeth; and whose gonothecae are irregular elongate sacs of circular section with a tubular mouth which is sometimes funnel-shaped, and arise both from normal hydrothecae and also from the stem between the hydrothecae.

This species is extremely variable both in compactness of growth and in the arrangement and shape of its hydrothecae; so much so, indeed, that, were there not a number of specimens in the collection, I should probably have been led to describe it under two or more names. As it is, the series between the extreme forms is complete. I am inclined to think that it is greatly subject to the "vegetative variation" of Mr Gardiner. It is kindred to *S. tuba* (Bale **7**, p. 87), but is not in any of its forms exactly like any species already known. It is common in the Archipelago, having been dredged in most of the Atolls in 20 to 36 fathoms, and taken on the reef at Hulule, Male Atoll, and Goidu, Goifurfehendu Atoll.

Genus *Thuiaria.*

12. *Thuiaria gracilis* (Allm.) subsp. (**6**, II. p. 70). The angle in the hydrothecae is not so sharp as that of the type, and the ridge within is less marked.

Dredged at Hulule, Male Atoll, in 30 fathoms.

13. *Thuiaria tenuis* (Bale) subsp. (**7**, p. 82).

The nodes are wanting in the specimens.

Taken on a calcareous weed at Maradu, Addu Atoll, and on a *Sertularia* in a dredging from 20 fathoms in N. Male Atoll.

14. *Thuiaria attenuata* (Hincks) subsp. (**14**, p. 247).

Unlike that of Hincks' type, the hydrocaulus of this form is unbranched, consisting of simple stems without pinnae arising from a branched, creeping hydrorhiza. In all other respects it is exactly like the type.

Schneider puts this species in *Dynamena* (= *Sertularia*), but it agrees better with his definition of *Thuiaria*.

Dredged in 25 fathoms in N. Male Atoll.

15. *Thuiaria maldivensis* n. sp. (Pl. LXIX. fig. 6.)

Definition: A *Thuiaria* whose hydrocaulus is not pinnate, the stems, which may reach a height of 1 cm. and have no hydrothecae on the lower part and no nodes except one just below the hydrothecae, arising separately from a creeping hydrorhiza; while the hydrothecae are set at moderately wide intervals, opposite, and turned sharply outwards with a crease, a short free part, and a point on each side of the opening.

Dredged in Suvadiva Atoll in 31 fathoms.

Genus *Sertularia*.

Sertularia has priority over *Dynamena* as a generic name for this group of species.

16. *Sertularia digitalis* Busk (**12**, p. 393; **7**, p. 101).

I can find no difference between my specimens and the type of this species as defined by Bale. As this author points out, there is a very great likeness between it and the *Desmoscyphus longitheca* of Allman from the West Indian region (**5**, p. 24).

Dredged in 20 fathoms in N. Male Atoll.

Genus *Idia*.

17. *Idia pristis* Lamouroux (**15**, p. 200; **7**, p. 113).

The hydrothecae of my specimens are directed more sharply outwards than those of Allman's and have a more pointed outline than Bale's.

Dredged in Suvadiva and N. Male Atolls in 38 and 25 fathoms respectively.

Family **Plumularidae.** Genus *Aglaophenia*.

18. *Aglaophenia phoenicea* (Busk) subsp. (**12**, p. 398; **7**, p. 159).

My specimens differ from Busk's, as figured by Bale, in the following ways: (1) the middle nematotheca is rather shorter and stouter, (2) the side nematothecae are more upright, (3) the sides of the hydrothecae are less deeply notched.

Dredged in Male, Addu, S. Nilandu, and Mahlos Atolls in 20—30 fathoms.

19. *Aglaophenia sinuosa* Bale subsp. (**8**, p. 790).

The middle nematotheca in the Maldive specimens has a wide, swollen end, unlike that figured by Bale.

Dredged in Male, Suvadiva, and N. Male Atolls in 25—38 fathoms.

20. *Aglaophenia delicatula* (Busk) sub.-sp. (**12**, p. 396; **7**, p. 167).

This Maldive form differs from the type in that the side nematothecae are shorter and stouter and the side teeth of the hydrothecae rather better marked.

The corbulae of this species have hitherto been unknown. They are present in the specimen and are "open," consisting of hydrocladia bearing gonophores arched over by long alternate branches, each bearing a double row of nematophores.

Dredged in S. Nilandu Atoll in 25 fathoms.

21. *Aglaophenia maldivensis* n. sp. (Pl. LXIX. fig. 8.)

Definition: An *Aglaophenia* which has an irregularly branched stem and hydrocladia on all the branches but not on the stem below the branches; the hydrothecae with a wide mouth opening forwards, in the middle of the free side a strong, curved tooth and above this on each side three lower, wider teeth; the middle nematotheca falling far short of the mouth of the hydrotheca, free for about a third of its length, and having a rather narrow opening; the intrathecal septum nearly transverse to the hollow of the hydrotheca at its point of origin, which is about at the level at which the middle nematotheca becomes free; the side nematotheca flask-shaped; and the corbula egg-shaped, made up of six broad, alternate plates with openings between their notched edges.

Taken on the reef at Hulule, Male Atoll.

22. *Aglaophenia schneideri* n. sp. (Pl. LXIX. fig. 9.)

Definition: An *Aglaophenia* with the stem unbranched (?); the hydrothecae opening somewhat forwards, the opening of each with a strong, curved, crested tooth in the middle, and two shorter, weaker teeth at each side, the first of these being sundered by a wide, deep gap from the middle tooth; the intrathecal septum slanting; the middle nematotheca not nearly reaching the mouth of the hydrotheca, wide mouthed, free for a short distance only.

I have called this species after Prof. C. Schneider, in gratitude for his masterly handling of the problem of the simplification of the classification of Hydroids.

Dredged in Miladumadulu Atoll, in 24 fathoms.

23. *Aglaophenia gracillima* n. sp. (Pl. LXIX. fig. 10.)

Definition: An *Aglaophenia* with the hydrocaulus very slender and delicate; the hydrothecae far apart, their openings slightly expanded, looking towards the end of the hydrocladium, and guarded by nine, equal, rather narrow teeth; the middle nematotheca reaching at its end to within about a quarter of the length of the hydrotheca from the opening of the latter, adnate to the hydrotheca for the greater part of its length and widely open at the end; the side nematophores short, broad, and directed somewhat forwards; and the intrathecal septum nearly transverse.

The shape of the hydrothecae somewhat recalls those of *A. acacia* and *A. calamus* Allm. (**6**, I. pp. 38, 39).

The collection contains only some fragments, dredged in 28 fathoms in Miladumadulu Atoll.

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BORRADAILE——HYDROZOA.

EXPLANATION OF PLATE LXIX.

FIG. 1. *Eudendrium maldivense*, whole stock, × base of a stalk enlarged.

FIG. 2. *Campanularia junceoides*, hydrotheca enlarged.

FIG. 3. *Lictorella halecoides*, end of branch with hydrothecae and gonotheca. One of the latter is also shown from the side.

FIG. 4. *Synthecium tubiger*, *a.* end of stock, *b.* two hydrothecae more highly magnified.

FIG. 5. *Synthecium maldivense*, *a.* whole colony, *b.* two pieces somewhat enlarged to show different arrangements of hydrothecae, *c.* two hydrothecae more highly magnified, *d.* a group of gonothecae, also highly magnified.

FIG. 6. *Thuiaria maldivensis*, *a.* whole colony, *b.* hydrothecae enlarged.

FIG. 7. *Aglaophenia delicatula*, corbula highly magnified. (The hydrocladia bearing gonophores are sometimes situated on the main stem and sometimes, as in the figure, on a side branch. The artist has in some cases omitted the stalks, of the gonophores, which really are attached to the central stem of the hydrocladium, so that they actually appear in places to have been budded from the side branches.)

FIG. 8. *Aglaophenia maldivensis*, *a.* whole colony, *b.* hydrotheca more highly magnified, front view, *c.* ditto side view.

FIG. 9. *Aglaophenia schneideri*, hydrotheca highly magnified.

FIG. 10. *Aglaophenia gracillima*, *a.* front view of hydrotheca, highly magnified, *b.* side view of the same.

NOTES ON PARASITES.

By A. E. Shipley, M.A., F.R.S., *Fellow and Tutor of Christ's College, Cambridge, and University Lecturer on the Morphology of the Invertebrata.*

Mr Stanley Gardiner's expedition had as its object the exploration of coral-reefs and was not concerned with parasites, nevertheless a few specimens were collected, and amongst these were some cysts from *Chelone mydas* Cuv. and from *Varanus bengalensis* Daud. which seem to be pathological rather than helminthological in character. These have been sent to the Cancer Research Laboratory, Victoria Embankment, which at present is anxious to obtain specimens of 'growths' in the lower vertebrata.

TREMATODA.

AMPHISTOMUM SPINULOSUM Looss.

Looss. "Notiz. z. Helminthol. Aegytens, IV." *Centrbl. Bakter.* v. 1900, p. 624.

Looss. "Ueber neue u. bekannte Trematoden aus Seeschildkröten," *Zool. Jahrb. Syst.* XVI. 1902, p. 430, figs. 10, 11, Pl. XXI. and figs. 12—16, Pl. XXII.

Four or five specimens were taken from the alimentary canal of the Green Turtle, *Chelone mydas* Cuv., killed at Minikoi. They were found living just where the small passes into the large intestine.

NEMATODA.

PHYSALOPTERA VARANI, Parona.

Parona. *Ann. Mus. Genova*, Ser. II. VII. 1899, p. 776.

This parasite was first described by Prof. Parona from *Varanus bengalensis* Daud., a scavenging lizard from Palon (Pegu). Mr Gardiner's numerous specimens were taken from the same species captured at Weligama, Ceylon. Some of them were fixed by their ends in the valleys between the rugae of the stomach walls, but the larger forms, the females, were free. I am indebted to Dr von Linstow for the identification of these specimens.

Zoological Laboratory, *October*, 1904.

RHYNCHOTA.

By W. L. Distant.

The 20 species of Rhynchota here enumerated belong to the sub-order Heteroptera. The collection also contained one or two species of small Homoptera belonging to obscure and little worked groups, which it is better to leave for the present, and identify when I have revised and worked up the Families to which they belong in the ensuing volumes devoted to my description of the Rhynchota of British India.

All the specimens are found in British India and mostly have a wide dispersal in that region. One *Serinetha abdominalis* Fabr. occurs in the Island of Sokotra; another, *Eusarcocoris guttiger* Thunb., is not uncommon in China and Japan; *Graptostethus servus* Fabr. has an eastern range to China and Australasia, and a western one from the South Palaearctic region to South Africa, a distribution which may probably be equalled by that of the aquatic species *Anisops sardea* Herr.-Schaeff. As far as this collection allows a conclusion to be formed, the Rhynchotal fauna of these islands consists entirely of migrants from the coasts of India and Ceylon.

HETEROPTERA.

Fam. **Pentatomidae.**

Subfam. **Cydninae.**

1. *Geotomus pygmaeus.*

Aethus pygmaeus Dall. *List Hem.* I. p. 120 (1851); *Geotomus pygmaeus* Sign. *Ann. Soc. Ent. Fr.* (6), III. p. 51, t. 3, f. 160 (1883); Dist. *Faun. Brit. Ind. Rhynch.* I. p. 98, fig. 49 (1902); *Cydnus rarociliatus* Ellenr. *Nat. Tijdschr. Nederl. Ind.* XXIV. p. 139, f. 7 (1862); *Cydnus pallidicornis* Voll. *Faun. Ind. Néerl. Pent.* p. 17 (1868); *Aethus palliditarsus* Scott, *Trans. Ent. Soc.* 1880, p. 309; *Geotomus subtristis* and *jucundus* Buch-White, *Ann. Mag. Nat. Hist.* (4) XX. pp. 110, 111 (1877); *Aethus nanulus* and *platysomoides* Walk. *Cat. Het.* I. pp. 162, 163 (1867); *Aethus omicron* Walk. *loc. cit.* III. p. 534 (1868).

Minikoi; Hulule. Generally distributed throughout British India, Malay Peninsula, and Malayan Archipelago.

Subfam. **Pentatominae.**

Div. *Sciocoraria.*

2. *Sciocoris lateralis.*

Sciocoris lateralis Fieb. *Rhynch.* p. 21 (1851); Dist. *Faun. Brit. Ind. Rhynch.* I. p. 126 (1902).

Minikoi. There is also a specimen from Coonoor in the Brit. Mus.

Div. *Eusarcocoriaria.*

3. *Sepontia variolosa.*

Coenina variolosa Walk. *Cat. Het.* I. p. 82 (1867).

Minikoi. Originally described from Burma, and also received from the Siamese Malay States.

4. *Eusarcocoris guttiger.*

Cimex guttiger Thunb. *Nov. Ins. Sp.* II. p. 32, t. 2, f. 47 (1783).

Maduwari, Mahlosmadulu; Minikoi. Found throughout British India, and in China and Japan.

Div. *Nezaria.*

5. *Nezara graminea.*

Cimex graminea Fabr. *Mant. Inst.* II. p. 295 (1787); *Acrosternum graminea* Stål, *Hem. Fabr.* I. p. 31 (1868); Atk. *J. A. S. Bengal,* LVII. p. 118 (1888); *Nezara graminea,* Dist. *Faun. Brit. Ind. Rhynch.* I. p. 221 (1902); *Cimex seladonius* Fabr. *Ent. Syst.* IV. p. 114 (1794); *Pentatoma lemur* Dohrn, *Stett. Ent. Zeit.* XXI. p. 401 (1860); Kirby, *J. Linn. Soc. Zool.* XXIV. p. 84 (1891).

Minikoi. Southern India and Ceylon.

6. *Zangis dorsalis.*

Raphigaster dorsalis Dohrn, *Stett. Ent. Zeit.* XXI. p. 401 (1860); *Zangis dorsalis,* Dist. *Faun. Brit. Ind. Rhynch.* I. p. 222, fig. 140 (1902); *Zangis virginea* Stål, *En. Hem.* V. p. 93 (1876).

Minikoi. A well-known Ceylonese species.

7. *Jurtina indica.*

Bathycoelia indica Dall. *List. Hem.* I. p. 270 (1851); *Jurtina indica* Stål, *En. Hem.* V. p. 102 (1876); Dist. *Faun. Brit. Ind. Rhynch.* I. p. 224, fig. 141 (1902).

Minikoi. Also known from Northern India, Bombay and Ceylon.

Fam. **Coreidae.**

Subfam. **Pseudophloeinae.**

Div. *Stenocephalaria.*

8. *Stenocephalus lateralis.*

Stenocephalus lateralis Sign. *Bull. Soc. Ent. Fr.* 1879, p. lviii.; Dist. *Faun. Brit. Ind. Rhynch.* I. p. 406, fig. 239 (1902); *Stenocephalus orientalis,* Dist. *Ent. Month. Mag.* XVI. p. 202 (1880).

Minikoi. Recorded from Bombay, Madras and Ceylon.

Subfam. **Alydinae.**

Div. *Alydaria.*

9. *Riptortus pedestris.*

Gerris pedestris Fabr. *Syst. Ent.* p. 727 (1775); *Cimex pedes* Gmel. *Syst. Nat.* I. IV. p. 2191 (1788); *Riptortus pedestris* Stål, *Hem. Fabr.* I. p. 64 (1868); Dist. *Faun. Brit. Ind. Rhynch.* I. p. 414, fig. 244 (1902).

Minikoi. Distributed throughout British India, including Burma and Ceylon, and also found in the Malay Peninsula.

10. *Riptortus fuscus.*

Lygaeus fuscus Fabr. *Ent. Syst. Suppl.* p. 539 (1798); *Alydus ventralis* Westw. in *Hope Cat.* II. p. 20 (1842); *Alydus major* Dohrn, *Stett. Ent. Zeit.* XXI. p. 402 (1860); *Riptortus fuscus* Stål, *Hem. Fabr.* I. p. 64 (1868); Dist. *Faun. Brit. Ind. Rhynch.* I. p. 414 (1902).

Minikoi. Similarly distributed as the last species.

Subfam. **Corizinae.**

Div. *Serinetharia.*

11. *Serinetha abdominalis.*

Lygaeus abdominalis Fabr. *Syst. Rhyng.* p. 226 (1803); *Leptocoris abdominalis* Burm. *Handb.* II. p. 305 (1835); *Lygaeomorphus abdominalis* Blanch. *Hist. des Ins.* III. p. 116 (1840); *Pyrrhotes abdominalis* Westw. in *Hope Cat.* II. p. 26 (1842); *Serinetha abdominalis* Stål, *Hem. Fabr.* I. p. 68 (1868); Dist. *Faun. Brit. Ind. Rhynch.* I. p. 419, fig. 246 (1902); *Lygaeus augur* (part) Fabr. *Ent. Syst.* IV. p. 161 (1794); *Leptocoris rufus* Hahn, *Wanz. Ins.* I. p. 201, fig. 102 (1831); *Serinetha taprobanensis* Dall. *List Hem.* II. p. 461 (1852); *Leptocoris bahram* Kirk. *Bull. Liverp. Muss.* II. p. 46 (1899).

Maldives; Inguradu and Heddufuri, Mahlosmadulu; Minikoi. Distributed throughout British India and Ceylon; Tenasserim. Also found in the Island of Sokotra. All the specimens collected by Mr Gardiner belong to the pale form to which Dallas gave the name *taprobanensis.*

Fam. **Lygaeidae.**

Subfam. **Lygaeinae.**

Div. *Lygaearia.*

12. *Graptostethus servus.*

Cimex servus Fabr. *Mant.* II. p. 300 (1787); *Lygaeus incomptus* Herr.-Scaeh. *Wanz. Ins.* VIII. p. 104, fig. 875 (1848); *Lygaeus ornatus* Uhler, *Proc. Ac. N. S. Philad.* 1860, p. 227; *Lygaeus inaequalis* Walk. *Cat. Het.* v. p. 57 (1872); var. *maculicollis* Germ. *Faun. Ins. Europ.* p. 24 (1817); vars. *nigriceps, manillensis* Stål, *En. Hem.* IV. p. 117 (1874); *Graptostethus servus* Stål, *Hem. Fabr.* I. p. 74 (1868); Dist. *Faun. Brit. Ind. Rhynch.* II. p. 8, fig. 4 (1903).

Maldives; Inguradu, Hulule; Minikoi. Widely distributed. Found throughout British India, including Ceylon and Burma, throughout Malayana to Australasia; recorded from China, found in the South Palaearctic Region, and common in South Africa.

Subfam. **Aphaninae.**

Div. *Myodocharia.*

13. *Pamera nietneri.*

Plociomerus nietneri Dohrn, *Stett. Ent. Zeit.* XXI. p. 404 (1860); *Pamera nietneri* Stal, *En. Hem.* IV. p. 151 (1874); Dist. *Faun. Brit. Ind. Rhynch.* II. p. 53 (1903).

Minikoi. Recorded from Ceylon and Burma.

Div. *Aphanaria.*

14. *Aphanus sordidus.*

Cimex sordidus Fabr. *Mant.* II. p. 302 (1787); *Rhyparochromus sordidus* Dall. *List Hem.* II. p. 566 (1852); *Beosus sordidus* Stål, *Hem. Fabr.* I. p. 78 (1868); *Aphanus sordidus*, Dist. *Faun. Brit. Ind. Rhynch.* II. p. 79, fig. 62 (1903); var. *Rhyparochromus pallens* Dall. *List Hem.* II. p. 567 (1852).

Maldives; Hulule. Found throughout British India to Tenasserim; China. Recorded by Stål from Guinea.

15. *Aphanus lineosus.*

Aphanus lineosus Dist. *Ann. Mag. Nat. Hist.* (7), VIII. p. 503 (1901); *Faun. Brit. Ind. Rhynch.* II. p. 80 (1903).

Minikoi. Recorded from Ceylon and Burma.

16. *Abdolominus intaminatus.*

Abdolominus intaminatus Dist. *Faun. Brit. Ind. Rhynch.* II. p. 91 (1903).

Minikoi. Originally described from the Karen Hills, Burma. In all the specimens collected by Mr Gardiner, the membrane does not reach the apex of the abdomen, and the upper surface is a little more melanic in hue than in the type.

Fam. **Pyrrhocoridae.**

Subfam. **Pyrrhocorinae.**

17. *Dysdercus cingulatus.*

Cimex cingulatus Fabr. *Syst. Ent.* p. 719 (1775); *Cimex superstitiosus* Thunb. *Nov. Ins. Sp.* III. p. 55, fig. 66 (1784), *excl. syn.*; *Cimex koenigii* Fabr. *Syst. Ent.* p. 720 (1775); *Astemma koeningii* Blanch. *Hist. des Ins.* p. 128, pl. IV. fig. 8 (1840); *Dysdercus cingulatus* Dist. *Faun. Brit. Ind. Rhynch.* II. p. 118, fig. 87 (1903).

Maldives; Hulule. Found throughout British India, Malayana, and recorded from Queensland.

Fam. **Cimicidae.**

18. *Cimex macrocephalus.*

Acanthia macrocephala Fieb. *Eur. Hem.* p. 135, *note* (1861); *Cimex macrocephalus* Dist. *Faun. Brit. Ind. Rhynch.* II. p. 411, fig. 262 (1904).

Maldives; Heddufuri, Mahlosmadulu; Minikoi. Also recorded from Burma.

Fam. **Capsidae.**

Subfam. **Mirinae.**

Div. *Miraria.*

19. *Megacoelum stramineum.*

Capsus stramineus Walk. *Cat. Het.* VI. p. 120 (1873); *Kangra dudgeoni* Kirk. *Trans. Ent. Soc. Lond.* 1902, p. 257; *Megacoelum stramineum* Dist. *Faun. Brit. Ind. Rhynch.* II. p. 428 (1904).

Minikoi. Already known from British India and Ceylon.

Fam. **Notonectidae.**

Subfam. **Notonectinae.**

20. *Anisops sardea.*

Anisops sardea Herr.-Schaeff. *Wanz. Ins.* IX. p. 40, fig. 904 (1850); Kirk. *Wien. Ent. Zeit.* XXIII. p. 114 (1904), *et syn.*; *Anisops nivea* Spin. (nec. Fabr.) *Ess. Hém.* p. 58 (1837); *Anisops productus* Fieb. *Rhynchograph.* p. 60 (1851); *Notonecta nanula* Walk. *Zoologist,* p. 2381 (1870); ? *Notonecta alba* Forskål, *Descr. Anim. Orient.* p. xxiii (1775).

Minikoi. Distributed throughout British India, and also in the South Palaearctic and Ethiopian Regions.

LES ALPHEIDAE.

Par H. Coutière, *Professeur à l'École de Pharmacie, Paris.*

(Plates LXX.—LXXXVII. et Texte-Figures 127—139.)

INTRODUCTION.

Les archipels des Laquedives et Maldives étant par excellence une "poussière" d'atolls madréporiques, il était permis de penser, à priori, que leur exploration méthodique apporterait une contribution importante à notre connaissance de la faune corallienne.

En ce qui concerne les Alpheidae, la richesse de la collection recueillie par MM. J. St. Gardiner et L. A. Borradaile dépasse tout ce que l'on pouvait espérer. Ces Eucyphotes se placent désormais au premier rang pour caractériser la faune variée qui demande aux récifs le vivre et le couvert.

La collection comprend 76 espèces et variétés, soit près de la moitié des formes actuellement connues d'Alpheidae, et, parmi ces formes, 48 sont nouvelles. Aucune expédition n'a jamais atteint, même de loin, un semblable résultat. Si la localité choisie s'est montrée exceptionnellement riche, il faut aussi que son exploration ait été conduite avec une méthode et une science de la recherche des espèces marines qu'on ne saurait trop mettre en relief.

Sur 83 stations, 62 ont été l'objet de dragages. En général, les fonds ainsi explorés sont compris entre 20 et 30 brasses (40 sur 62). 14 dragages ont été effectués entre 30 et 50 brasses, un seul par 70 brasses. Le reste, soit 7, par 1—20 brasses.

La grande majorité des formes inédites se trouve dans ces matériaux, provenant, sauf de rares exceptions, des Maldives. Il va de soi que cette méthode fournit peu d'indications bionomiques utilisables. La nature des matériaux ramenés par la drague ne peut plus guère servir pour reconstituer l'habitat d'une espèce, aussitôt que celle-ci est accompagnée de plusieurs autres, rarement recueillies *in situ*.

Le reste de la collection provient de recherches sur le récif, principalement à Minikoi, atoll principal des Laquedives. Cette recherche, que j'ai moi-même pratiquée avec succès à Djibouti, et qui permet d'observer les mœurs et l'habitat si curieux de certaines espèces, a donné ici encore nombre de formes nouvelles.

L'examen de cette collection m'a obligé à revoir de très près une grande partie des spécimens conservés au Muséum de Paris, dont je n'avais pu aborder on terminer encore

l'étude systématique. J'ai pu y retrouver de nombreuses espèces des Laquedives et Maldives, restées indéterminées ou douteuses jusqu'alors, faute de spécimens en quantité et de qualité suffisante. C'est ainsi également que j'ai dû rectifier plusieurs synonymies d'espèces, que j'avais données dans mon travail de 1896 sur les Alpheidae, et qui ne m'ont pas paru devoir être maintenues, devant la diversité toujours plus grande des formes spécifiques, et l'imprécision croissante des anciennes diagnoses qui en résulte.

Six genres, parmi les Alpheidae, ont ainsi reçu, par l'étude de la présente collection, des additions d'importance variable. Les genres *Automate, Athanas, Arete, Alpheopsis* s'augmentent de 7 espèces. Jusqu'en 1903, le genre *Automate* en comptait une seule, il en a 4 actuellement recueillies en des points qui jalonnent toute la zone intertropicale: Atlantique est et ouest, Océan Indien, Pacifique.

Le genre *Athanas,* plus riche en espèces, est moins largement distribué jusqu'ici. Encore est-ce la première fois qu'il est signalé au delà de la côte orientale d'Afrique.

Depuis Stimpson, aucune espèce n'était venue s'ajouter à l'*Arete dorsalis.* Le genre en compte maintenant 4, avec une distribution assez semblable à celle des espèces d'*Automate.* La plus remarquable est l'*A. Borradailei* décrite ci-après. En comparant les deux espèces nouvelles d'*Athanas, A. Naifaroensis* et *A. areteformis,* avec l'*A. Borradailei,* on assiste en effet au mécanisme par lequel les espèces des deux genres ont pu diverger assez pour ne plus pouvoir être maintenus dans une même coupe générique. Aucun autre exemple parmi les Alpheidae, n'illustre avec une netteté aussi tangible le recouvrement graduel des ophtalmopodes par des expansions du bord frontal de la carapace, recouvrement dont on connaît la perfection singulière chez des espèces telles que l'Alphée frontale.

Le genre *Synalpheus* s'augmente de 12 espèces ou variétés. C'est dire qu'il est plus que doublé. C'est un groupe très cohérent, relié aux Hippolytidae par des caractères très apparents; un genre de vie identique a donné en outre un facies commun à la plupart de ses espèces. Elles sont commensales des Madrépores ou des Éponges, sédentaires, lentes à se mouvoir, de formes arrondies et trapues. Elles doivent sans doute à ces conditions éthologiques communes d'avoir offert peu de prise à des variations persistantes, et fixées sous forme spécifique; les caractères des espèces s'y montrent toujours rares, et peu visibles, plusieurs sont fondés sur l'atténuation variable de détails propres aux Hippolytidae et qui persistent ici. Les espèces faciles à distinguer dans le genre sont précisément celles qui possèdent un genre de vie très tranché, *S. comatularum,* par exemple, dont le nom indique suffisamment le commensalisme.

Dans le genre *Alpheus,* le nombre de formes nouvelles est tel qu'il a été nécessaire de démembrer le groupe "crinitus" que j'avais constitué en 1896. Les espèces de ce groupe ressemblent, par "convergence," à celles du genre *Synalpheus,* dont elles partagent le genre de vie sédentaire, les formes massives, la tendance à la réduction du scaphocérite. Les unes et les autres sont les plus hautement caractéristiques des récifs dont elles peuplent les interstices s'il s'agit de Madrépores cespiteux, ou les trous et les galeries, s'il s'agit de blocs compacts creusés par les Mollusques saxicaves. La liste des espèces offre une ample confirmation de ce fait: les 3/4 des espèces sont nouvelles, dans le groupe "crinitus" tout entier, les 9/11 dans le sous-groupe du même nom. Le groupe "obeso-manus," que j'en ai séparé, n'en diffère pas comme habitat et genre de vie, le second, que j'ai appelé "insignis," est moins homogène, aussi bien dans la morphologie que dans l'éthologie des espèces qui le constituent.

Parmi les nombreuses formes du groupe "crinitus" s. str., les *A. aculeipes*, *paraculeipes*, *paralcyone*, auxquels il faut joindre les *A. alcyone* de Man, le *A. spongiarum* H. Coutière, absents de la liste, sont séparés par des différences très faibles, portant plutôt sur le degré d'atténuation ou d'exubérance de détails communs que sur la présence ou l'absence de ces détails. De sorte que l'on échappe difficilement à cette impression qu'il s'agit d'espèces de formation actuelle, résultant de variations en voie de se fixer. Le fait est particulièrement net pour l'*A. spongiarum*, toujours facile à distinguer de l'*A. paraculeipes* par quelques minimes détails très constants, et dont l'habitat dans les oscules d'Éponges est d'une constance non moins grande. Tout se passe comme s'il y avait corrélation entre les différences de forme et les différences d'habitat.

Une autre espèce intéressante, du groupe "brevirostris," est l'*A. Miersi*, où j'ai pu relever, grâce au grand nombre des spécimens, un dimorphisme des plus nets, portant uniquement sur les ♂, et dont il existe quelques autres exemples chez les Décapodes et les Isopodes, parmi les Crustacés.

Les espèces du groupe "Edwardsi" sont les plus grandes du genre *Alpheus*, et parmi les plus anciennement connues. La séparation de quelques-unes d'entre elles, voisines de l'*A. Edwardsi*, est assez malaisée. Là encore, il semble que l'on se trouve en face de formes d'isolément spécifique récent, dont les différences n'apparaissent vraiment que sur des spécimens bien adultes, et qui offrent de nombreuses variétés locales. Pour la plupart, ces espèces, de même que celles du groupe "brevirostris," sont moins étroitement liées aux Polypiers morts ou vivants que celles du groupe "crinitus." Ce sont des espèces actives, dont le territoire de chasse est plus étendu et plus varié. C'est là aussi que l'on trouve, sous sa forme la plus hautement perfectionnée, le singulier appareil d'intimidation et d'attaque qu'est la grande pince de la 1re paire, avec ses dispositifs de détente et de frénation.

Genre *Automate* de Man.

1. *A. Gardineri* H. Coutière (fig. 127, 128).

Automate Gardineri H. Coutière, *Bull. du Muséum*, No. 6, 1902.

Longtemps réduit à la seule *A. dolichognatha* de Man, le genre *Automate* compte aujourd'hui 5 espèces dont la distribution embrasse la zone intertropicale entière, au nord de l'équateur. La nouvelle espèce est très voisine de l'*A. dolichognatha* de Man.

Le fond de l'échancrure du bord frontal présente une convexité antérieure très marquée, et les côtés de ce lobe médian ont une tendance à se continuer sur la carapace le long d'une légère dépression (fig. 127 *a*).

L'article proximal du pédoncule antennulaire (portion visible) n'a guère que la moitié de la longueur des ophtalmopodes. L'article médian, de longueur variable avec l'âge des spécimens, est égal au précédent chez les adultes, ou même légèrement plus long. L'article distal a, chez les adultes, le tiers environ de la longueur du médian.

Le scaphocérite dépasse légèrement la moitié de l'article antennulaire médian. Le pédoncule antennaire ne dépasse que très peu en longueur celui des antennules.

Les maxillipèdes externes comme chez l'*A. dolichognatha*. Cette description du bord frontal et des appendices céphaliques s'applique aux deux sexes. On ne peut y relever, comme

différence sexuelle, que la présence de 13 articles à la hampe du fouet antennulaire externe chez le ♂, au lieu de 12 chez la ♀. Cette différence existe d'ailleurs chez l'*A. dolichognatha*.

La forme des membres de la première paire différencie nettement les deux espèces. Dans les exemplaires des Maldives, une seule grande pince, détachée, peut être attribuée à un ♂ (fig. 127 *c, d, e*). La comparaison avec un exemplaire très adulte provenant de Mascate (M. Maindron, Collections du Muséum) ne permet aucun doute. La pince est rectangulaire, à bords parallèles, les doigts sont un peu plus longs que la paume, et celle-ci est un peu plus longue que haute.

Le carpe est fortement élargi en avant, et son bord distal est trilobé. Le méropodite, fortement renflé, est environ 2 fois aussi long que le carpe, et ses bords sont distincts de ceux de l'ischiopodite, renflé à son extrémité distale (fig. 127 *d, e*).

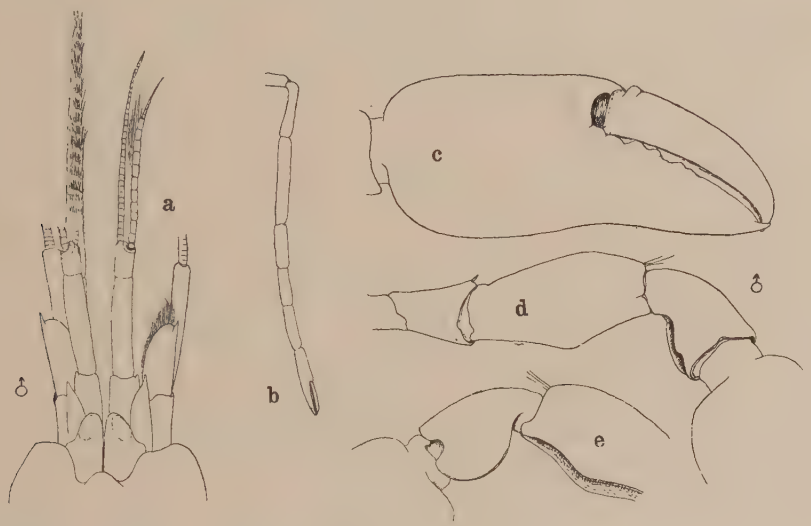


Fig. 127. *Automate Gardineri* H. C. *a.* spécimen ♂ (type), région frontale, ×10; *b.* grande pince de la 1re paire, ×10. *c.* carpe, méro- et ischiopodite, vus en dedans, ×10; *d.* carpe et méropodite, vus en dehors, ×10; *e.* carpe de la 2me paire, ×10.

Chez la ♀, la grande pince est de forme différente (fig. 128 *b*). Les doigts n'ont plus que les 2/5 de la longueur de la paume, et la moitié de sa hauteur. Le rapport de la longueur à la hauteur, pour la pince entière, est toujours inférieur à 2, alors qu'il dépasse presque toujours ce chiffre chez l'*A. dolichognatha* ♀, dont la grande pince est plus longue et moins renflée.

Le carpe est court, trilobé, très élargi distalement, avec une forte saillie triangulaire sur son bord inférieur, du côté de la pointe du doigt mobile (fig. 128 *c*). Cette saillie n'est pas présente sur la grande pince détachée du ♂, décrit plus haut, mais elle existe sur l'exemplaire ♂ de Mascate, moins accentuée toutefois que chez les ♀ des Maldives. On ne la trouve jamais chez l'*A. dolichognatha*.

Le méropodite (fig. 128 *c*) est court et fortement renflé en son milieu; le rapport de sa longueur et de sa largeur est de 1·38 à 1·5 au lieu de 1·6 à 2 chez l'*A. dolichognatha*.

De même que chez le ♂, l'ischiopodite est fortement renflé distalement, et ne continue pas les bords du méropodite ainsi qu'il le fait chez l'*A. dolichognatha* (fig. 128 *d*).

Sur la deuxième paire, dans les 2 sexes, les segments 3 et 5 du carpe sont égaux, le segment 4 un peu plus petit (fig. 127 *e*).

Fig. 128. *Automate Gardineri* H. C. *a.* spécimen ♀ (type), région frontale, ×10; *b.* grande pince de la 1re paire; *c.* carpe, méro- et ischiopodite, vus en dehors, ×25.
Automate dolichognatha de Man. *d.* carpe, méro- et ischiopodite, vus en dehors, ×25.

Minikoi, Maduwari Mahlos Atoll, Goidu Atoll, Hulule Male Atoll, 10 ex. ♂ et ♀. L'espèce se rencontre aussi à Mascate (Maindron), Djibouti (H. Coutière), et à Kingsmill Island (Coll. de Yale College, U.S.A.).

Je n'ai pas rencontré l'*A. dolichognatha* parmi les spécimens des Laquedives et Maldives.

Genre *Athanas* Leach.

2. *Athanas Djiboutensis* H. Coutière (fig. 129).

A. Djiboutensis H. C., *Bull. du Muséum*, No. 6, p. 233, 1897.

„ „ *Ann. des Sc. nat.* (6), p. 62, 177; fig. 4, 207, 1899.

A. sulcatipes Borradaile, *P.Z.S.* p. 1011, pl. 65, fig. 9, 1898.

M. L. A. Borradaile a bien voulu me soumettre les types de l'*A. sulcatipes*, provenant de Funafuti Atoll (Arch. Fiji). J'ai pu me convaincre de la parfaite identité de cette espèce avec l'*A. Djiboutensis*, dont la distribution géographique se trouve ainsi très étendue.

C'est une des formes les plus typiques du genre *Athanas*. Le rostre peut atteindre presque l'extrémité du pédoncule antennulaire; ses bords sont parallèles sur 1/3 de leur longueur, puis convergent en pointe aiguë, légèrement relevée. Les épines supra-cornéennes sont bien détachées du rostre, fortes et triangulaires. Des deux épines extra- et infra-cornéennes, l'inférieure est la plus grande, sans atteindre toutefois le bord de la cornée (fig. 129 *a*, *b*).

Le stylocérite n'atteint pas d'ordinaire l'extrémité de l'article antennulaire médian.

Les pattes de la première paire montrent un dimorphisme sexuel très accusé, et de plus, dans l'un et l'autre sexe, une asymétrie surtout marquée chez les ♀.

Chez le ♂, les deux membres ont, à un degré un peu inégal, le méropodite très volumineux, à bords foliacés et engaînants. Le carpe de la grande pince est très court, de forme hémisphérique, le propodite est ovoïde, un peu plus renflé distalement, la partie se plaçant dans la gaîne du méropodite est un peu aplatie de part et d'autre d'une crête longitudinale très peu marquée. Les doigts, béants, sont armés de tubercules rugueux, le doigt mobile étant courbé en demi-cercle (fig. 129 *c*).

Sur le membre opposé, plus petit, la partie médiane du carpe, dirigée en avant quand la pince est repliée, affecte la forme d'une saillie conique très caractéristique. Le propodite est beaucoup moins renflé, et les doigts presque inermes (fig. 129 *d*).

Chez la ♀, les pinces sont beaucoup plus dissemblables. La plus grande ressemble assez à la plus petite du ♂; le méropodite est toutefois plus long, moins engaînant, le propodite presque cylindrique; le carpe n'a pas de prolongement conique (fig. 129 *e*).

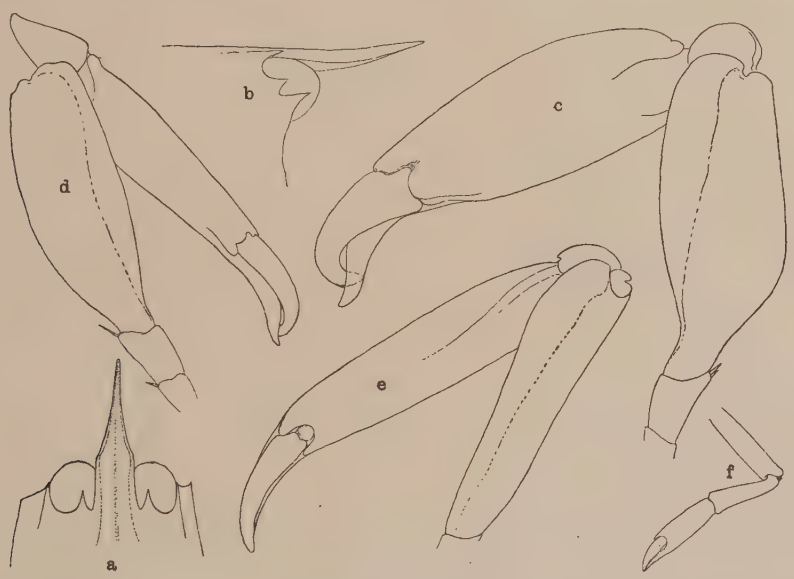


Fig. 129. *Athanas Djiboutensis* H. C. *a.* spécimen ♂ (type), région frontale, ×30; *b.* spécimen ♂ (type), région frontale (vue latéralement), ×30; *c.* patte de la 1re paire (grande pince); *d.* patte de la 1re paire (petite pince); *e.* ♀, patte de la 1re paire (grande pince); *f.* ♀, patte de la 1re paire (petite pince).

Le membre opposé est très grêle, sa longueur totale n'atteint pas celle du méropodite du précédent. Le méro- et le propodite (doigts compris) sont sensiblement égaux, le carpe un peu plus court. Tous ces articles sont grêles, cylindriques, les doigts inermes joignent exactement (fig. 129 *f*).

Naifaro Reef, Hulule Male Atoll, Minikoi Island, récifs et lagon (1 ex. provenant de cette dernière station a été capturé dans les trous d'une pièce de bois perforée par les Tarets).

L'espèce se rencontre aussi à Djibouti (H. Coutière), et à Funafuti, Ellice Island (J. St. Gardiner).

3. *Athanas Minikoensis* n. sp. (fig. 130).

Cette espèce est extrêmement voisine de l'*A. dimorphus* Ortmann. Elle en est toutefois facile à distinguer, et je n'hésite pas à la considérer comme nouvelle, bien qu'elle soit représentée par un unique spécimen ♀, mutilé.

Par la forme du rostre, l'absence totale d'épine supra-cornéenne, par l'épine extra-cornéenne un peu plus grande que l'épine inférieure, la nouvelle espèce (fig. 130 *a*, *b*) est entièrement semblable à l'*A. dimorphus* tel que l'a décrit Ortmann et tel que je l'ai retrouvé à Djibouti. La différence porte uniquement sur les membres de la première paire, dont un seul est présent sur le type.

Chez l'*A. dimorphus* ♀ (fig. 130 *d*) ces membres sont égaux et très grêles. Le méropodite, légèrement engaînant, et le carpe, plus court, sont l'un et l'autre allongés et cylindriques; ils ont, surtout le carpe, un peu moins de 2 fois la longueur du propodite (doigts compris). Ce dernier article est lui-même cylindrique dans toute sa longueur; les doigts, inermes et joints, ont la moitié de la longueur de la paume.

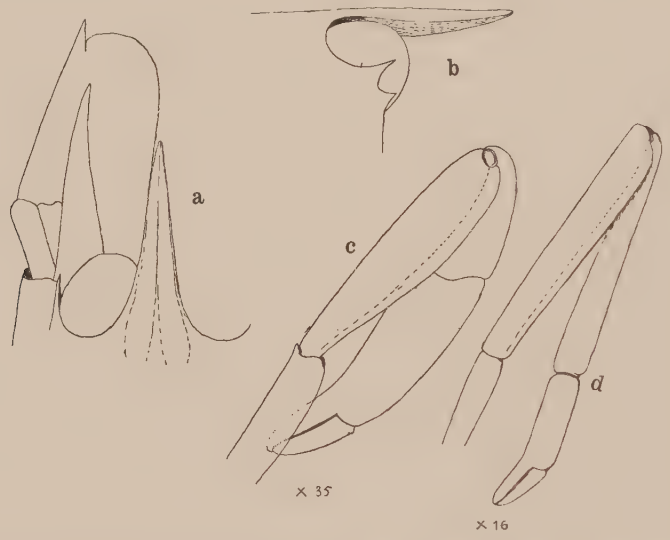


Fig. 130. *Athanas Minikoensis* H. C. *a*. spécimen ♀ (type) région frontale, × 25; *b*. spécimen ♀ (type) région frontale vue latéralement, × 25; *c*. patte de la 1re paire, petite pince, × 25.
Athanas dimorphus Ortmann. *d*. patte de la 1re paire, petite pince, × 10.

Chez l'*A. Minikoensis* (fig. 130 *c*), le membre entier est beaucoup plus robuste. Le méropodite, nettement engaînant dans sa partie distale, est deux fois aussi long que le carpe, celui-ci étant à peu près égal à l'ischiopodite, et de forme conique. La paume est légèrement ovoïde, seulement un peu plus courte que le méropodite; la pince, doigts compris, est plus longue que ce dernier article. Les doigts sont inermes et joints. La forme du membre opposé reste jusqu'à présent inconnue, de même que les caractères du ♂.

Minikoi Atoll, "Boulder" zone.

Je n'ai pas trouvé l'*A. dimorphus* Ortmann parmi les espèces des Maldives et Laquedives. On doit vraisemblablement l'y rencontrer, l'espèce étant connue dans la mer Rouge, depuis Heller et Paulson, à Perim (Dr Jousseaume), Suez, Djibouti (H. Coutière), Dar-es-Salaam

(Ortmann), en Nouvelle-Calédonie (V. Bougier), aux îles Fiji (J. St. Gardiner). (Cette dernière station, d'après un spécimen ♀ mutilé qu'a bien voulu me communiquer M. Borradaile, et dont la détermination reste incertaine.)

4. *Athanas Naifaroensis* n. sp. (fig. 131).

Cette espèce n'est jusqu'à présent représentée que par des spécimens ♀. Elle rappelle l'*A. Djiboutensis* par quelques caractères du bord frontal, mais elle est alliée beaucoup plus étroitement, par la forme des membres, à l'espèce Atlantique et Méditerranéenne *A. nitescens* Leach.

Le rostre (fig. 131 *a, b*) a ses bords parallèles sur le tiers proximal de sa longueur. Il s'étend jusqu'à l'extrémité de l'article antennulaire médian, parfois jusqu'au milieu de l'article distal. Les épines supra-cornéennes sont plus marquées encore que chez l'*A. Djiboutensis* (et à fortiori que chez l'*A. nitescens* où elles sont très faibles), elles ont les 2/3 du diamètre antéro-postérieur de la cornée. L'épine extra-cornéenne, très développée, dépasse longuement le bord de la cornée, alors que l'infra-cornéenne est très petite et assez difficilement visible, son extrémité transparente se confondant avec le bord inférieur sombre de la cornée (fig. 131 *a, b*).

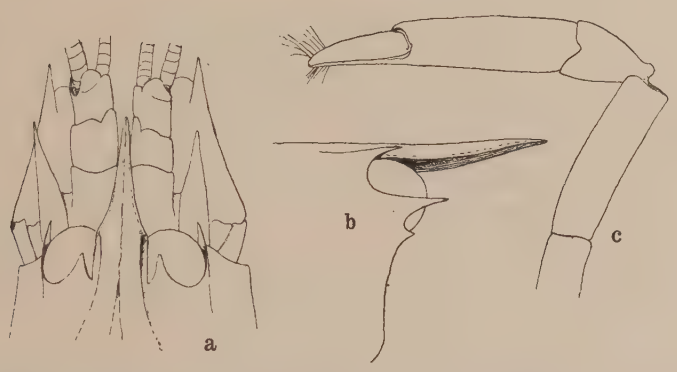


Fig. 131. *Athanas Naifaroensis* H. C. *a.* spécimen ♀ (type), région frontale, ×25; *b.* spécimen ♀ (type) vu latéralement, ×25; *c.* patte de la 1re paire, ×25.

Le stylocérite s'étend jusqu'à l'extrémité de l'article antennulaire médian.

Les membres de la première paire (chez la ♀) sont presque égaux et semblables (fig. 131 *c*). Ils permettent de ranger la nouvelle espèce dans le groupe "*nitescens*" du genre *Athanas*, groupe dans lequel les pinces restant étendues en avant du carpe, leur poids est compensé par le raccourcissement du méropodite. (Dans un second groupe "*dimorphus*," au contraire, la pince se repliant dans le méropodite, celui-ci est amené à prendre un développement exagéré. Il en résulte que dans l'une et l'autre disposition, le centre de gravité de l'animal chargé de ses pinces reste sensiblement au même point.)

Chez l'*A. Naifaroensis*, le méropodite est court, convexe en dessus, concave en dessous sans être engaînant; le carpe, conique, embrasse l'extrémité proximale du propodite, il a la moitié de la longueur du méropodite.

Le propodite (doigts non compris) est un peu plus long que le méropodite sur la plus grande des pinces, un peu plus court sur le membre opposé, de forme légèrement ovoïde. Les doigts, égaux en longueur au carpe, sont clos et inermes (fig. 131 *c*).

Bien que la forme des pinces présente d'assez grandes variations chez les ♀ de l'*A. nitescens*, il est toujours possible de distinguer les deux espèces par ces appendices. Le carpe est toujours, chez l'*A. nitescens* ♀, plus long et plus étroit, il égale fréquemment en longueur le méropodite.

Naifaro Reef (1 ♀), Hulule Male Atoll (6 ♀).

5. *Athanas areteformis* n. sp. (fig. 132).

Je considère cette nouvelle forme comme étant de valeur spécifique, bien qu'elle soit très voisine de la précédente et qu'elle en dérive manifestement. Elle en diffère (au moins chez les ♀, seules connues entièrement) par un unique caractère, la disparition totale de l'épine infra-cornéenne ou angle externe de l'orbite.

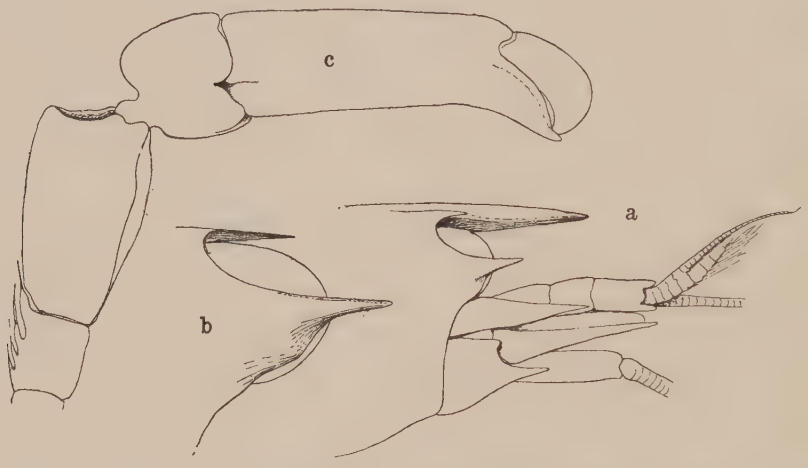


Fig. 132. *Athanas areteformis* H. C. *a*. spécimen ♂ (type), ×25; *b*. détail des saillies cornéennes, ×50; *c*. patte de la 1re paire, ×25.

Mais ce caractère, qui semble devoir définir une simple variété de l'espèce *Naifaroensis* si l'on considère ces formes isolément, prend une importance singulière lorsqu'on en rapproche les espèces du genre *Arete*, surtout l'*Arete Borradailei* n. sp., que je décris plus loin. L'absence de l'épine infra-cornéenne définit ici le genre, au même titre que les autres caractères distinctifs d'*Arete*, et en se fortifiant par eux. Rien ne saurait mieux montrer la réalité de la filiation de ces deux groupes de formes, *Athanas* et *Arete*, que cette augmentation subite de valeur que l'on est forcé d'attribuer à un caractère commun lorsqu'on passe d'un groupe à l'autre.

Chez l'*Athanas areteformis* (fig. 132 *a*, *b*) les épines supra- et extra-cornéenne, cette dernière surtout, paraissent être encore plus développées que dans l'espèce précédente.

L'espace occupé par l'épine infra-cornéenne n'est plus indiqué que par un bord à légère convexité antérieure, sensiblement parallèle à la circonférence de la cornée. Tous les autres caractères des appendices céphaliques sont rigoureusement ceux de l'espèce précédente.

Une seule des pattes de la première paire est présente sur un spécimen ♀. Elle ne diffère aucunement de son homologue chez l'*A. Naifaroensis*.

Quant aux pattes de la première paire chez le ♂, elles sont représentées par une pince détachée, accompagnant l'unique exemplaire ♂ que j'ai étudié, et que l'on peut lui attribuer

avec d'autant plus de vraisemblance que cet appendice rappelle de très près son homologue chez l'*A. nitescens*. Le méropodite est court, de forme triquètre, le carpe hémisphérique, embrassant l'extrémité de la paume, le propodite cylindrique et robuste. Le doigt mobile, courbé en demi-cercle, ne porte pas de tubercules, peut-être s'agit-il de la plus petite des deux pinces du spécimen (fig. 132 *c*).

Naifaro Reef, Fadifolu Atoll (1 ♂), Hulule Male Atoll (1 ♀).

Genre *Arete* Stimpson.

6. *Arete Borradailei* n. sp. (fig. 133).

Le genre *Arete* comprenait jusqu'à présent l'unique espèce *A. dorsalis* Stimpson, recueillie près de Hong-Kong. En raison même de la concision de la diagnose de Stimpson, c'est à cette espèce que les auteurs, en particulier de Man, et moi-même, avaient rapporté les spécimens trouvés ailleurs que sur la côte Chinoise. En réalité, il faut distinguer deux espèces dans les spécimens définis *A. dorsalis*, et il est assez délicat de dire à laquelle se rapporte la description du type.

Réduit à ces deux formes, très voisines l'une de l'autre, le genre *Arete* se laissait dériver d'*Athanas* avec facilité et paraissait même être, à partir de l'*Athanas nitescens* Leach, la forme la plus voisine que l'on pût distinguer génériquement. MM. St. Gardiner et Borradaile viennent d'ajouter au genre *Arete* une espèce très remarquable, qui vient se placer exactement à la suite des formes nouvelles d'*Athanas* décrites ci-dessus, mais qui, d'autre part, ressemble assez aux espèces connues d'*Arete* pour que son attribution à ce genre ne fasse aucun doute. C'est, en un mot, un "témoin" des plus irrécusables du processus qui a peu à peu séparé du genre *Athanas* des formes plus évoluées.

Le rostre, les ophtalmopodes, le bord frontal de l'*Arete Borradailei* (fig. 133 *a*, *b*) rappellent étroitement les détails homologues chez l'*Athanas areteformis* (fig. 132); mais le rostre s'est rétréci à la base, raccourci jusqu'à l'extrémité de l'article antennulaire médian, et notablement épaissi. Les épines supra-cornéennes ont pris un développement considérable, elles recouvrent de plus en plus les cornées et permettent de comprendre comment, chez l'*Arete dorsalis*, l'extrême pointe de ces épines est seule visible, l'échancrure qui les sépare du rostre s'étant comblée. Je rappelle que la protection de plus en plus grande des ophtalmopodes est un des points les plus saillants de la morphologie comparée des Alpheidæ.

Une seule épine, à base très large, est présente latéralement. En ne considérant que l'*Arete dorsalis*, j'avais pensé, dans un travail antérieur, que cette saillie du bord frontal était l'épine infra-cornéenne, ou angle externe de l'orbite, d'autant plus qu'une très légère convexité, située au-dessus, pouvait s'interpréter comme le vestige de l'épine extra-cornéenne, englobée dans le "rideau" recouvrant peu à peu les ophtalmopodes.

La comparaison d'*Athanas Naifaroensis* (fig. 131), *areteformis* et d'*Arete Borradailei* (fig. 133) prouve que, contre toute vraisemblance, c'est au contraire l'infra-cornéenne qui a graduellement disparu; à l'épine extra-cornéenne revient bien chez *Arete*, comme chez tous les Alpheidae, le principal rôle dans la constitution des voûtes orbitaires, et l'existence de cette formation, considérée comme hautement caractéristique des Alpheidae, est plus générale encore que je ne l'avais pensé.

Les antennules sont bien celles du genre *Arete*. L'article distal du pédoncule a subi un allongement marqué, le bord de chacun des deux autres articles est crénelé, le stylocérite n'atteint pas l'extrémité de l'article médian. La hampe du fouet externe antennulaire conserve, comme chez *Athanas*, 4 articles, mais ils sont très accrus en dimension, alors que les 2 fouets terminaux sont très courts (fig. 133 *a*).

Le scaphocérite est largement arrondi par son bord interne, plus long que le pédoncule antennulaire. Le basicérite est épais et trapu, avec une large épine obtuse latérale.

Les maxillipèdes externes sont aussi ceux d'*Arete*, par leur article médian très élargi et aplati (fig. 133 *b*).

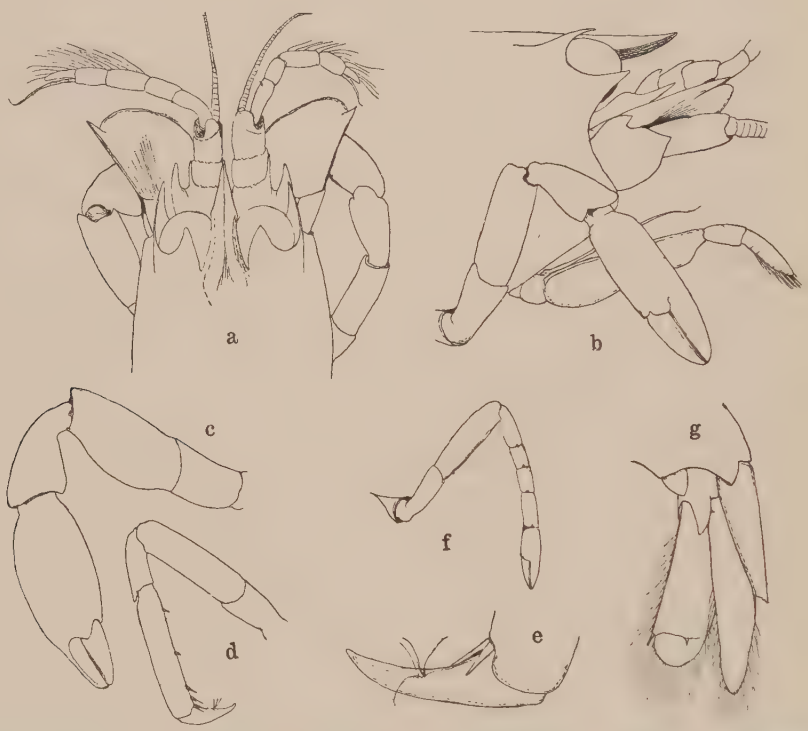


Fig. 133. *Arete Borradailei* H. C. *a*. spécimen ♀ (type), ×25; *b*. spécimen ♀ (type) vu latéralement, ×25; *c*. patte de la 1re paire, grande pince, ×25; *f*. patte de la 2e paire, ×25; *d*. patte de la 3re paire, ×25; *e*. patte de la 3re paire (dactylopodite), ×50; *g*. uropodes et telson, ×25.

Les pattes de la première paire (fig. 133 *b, c*) sont très semblables à celles de l'*Athanas Naifaroensis* ♀, l'*Arete Borradailei* n'étant également représenté que par une ♀. Le méropodite est toutefois plus volumineux et plus court, étant seulement 1 fois 1/2 plus large que long; le doigt mobile, externe chez *Athanas*, est ici à peu près complètement inférieur, comme dans le genre *Betaeus*, et s'ouvre de haut en bas.

La deuxième paire, comme chez *Arete*, n'a que 4 articles au carpe, les deux médians égaux, les deux extrêmes plus longs, surtout l'article proximal (fig. 133 *f*).

Les pattes suivantes (fig. 133 *d*) sont robustes, le propodite cylindrique est presque inerme (4—5 faibles spinules). Le dactyle est simple (fig. 133 *e*) mais porte en son milieu une trace de denticulation, marquée par un groupe de soies, indice du dactyle bifide de l'*Arete dorsalis*.

Le telson de l'unique spécimen est mutilé, mais les uropodes allongés, avec leur sympodite armé d'une large pointe mousse, sont bien ceux d'*Arete* (fig. 133 *g*).

Les membres thoraciques ne portent aucun épipodite, comme dans le genre *Synalpheus*, alors qu'il y a chez *Arete* 3 épipodites en crochets (sur les appendices *i*, *k*, *l*) et 4 chez *Athanas* (sur *i*, *k*, *l*, *m*). Il existe d'autres exemples d'anomalies comparables chez les Alpheidae ; *Betaeus aequimanus* Dana, *Alpheopsis trispinosus* Stimpson n'ont que 3 épipodites en crochet, alors qu'on en compte 5 dans les autres espèces de ces deux genres. Ce sont là des rudiments de formations branchiales d'un caractère très primitif, dont la disparition s'achève sans règles bien visibles, et l'exemple de l'*Arete Borradailei* montre qu'il serait imprudent de fonder sur leur nombre les rapports de parenté de deux groupes de formes, parmi les Eucyphotes.

Par la forme générale du rostre et du bord frontal, le petit nombre d'articles au fouet antennulaire externe, la forme générale des pattes de la première paire, le dactyle simple des péréiopodes 3, 4, 5, l'*Arete Borradailei* appartient encore au genre *Athanas*, surtout si l'on considère que chez les *Athanas Naifaroensis* et *areteformis*, pour passer à la nouvelle espèce, la disparition de l'épine infra-cornéenne est aussi graduelle que possible. Mais les caractères du genre *Arete* s'y montrent bien plus nombreux : épaississement du rostre, protection plus grande des ophtalmopodes, disparition de tout vestige de l'épine infra-cornéenne, élongation de l'article antennulaire distal, réduction des branches terminales du fouet antennulaire externe, doigt mobile des pinces de la première paire s'ouvrant du haut en bas, deuxième paire avec 4 articles au carpe, trace de denticulation des dactyles 3, 4, 5, uropodes allongés.

D'autre part, l'*Arete Borradailei* ne se place pas, dans le genre *Arete*, comme un échelon intermédiaire entre *Athanas* et les formes les plus évoluées du genre, telles qu'*Arete dorsalis*, et *Arete Indicus* décrite ci-après. La différenciation, à partir d'*Athanas*, s'est effectuée dans deux directions bien reconnaissables, probablement même à partir de formes distinctes. Pour les *Arete dorsalis* et *Indicus*, cette direction est jalonnée de façon moins précise, et, si l'on en juge par l'accroissement rapide du nombre des espèces chez *Athanas*, il est permis de penser que ce genre, de même qu'*Arete*, fournira encore des formes instructives pour l'étude de cette filiation.

L'unique exemplaire de l'*Arete Borradailei* (♀ portant des œufs) provient de Hulule Male Atoll.

7. *Arete Indicus* n. sp. (fig. 134, 135).

Arete dorsalis var. *Indicus*, H. Coutière, *Bull. Soc. Philom.* 9, v., p. 85, 1903.

Depuis la note préliminaire où je montrais la nécessité de séparer, en deux variétés au moins, les spécimens que j'avais jusqu'alors confondus sous le nom d'*Arete dorsalis* Stimpson, j'ai pu examiner d'autres exemplaires du genre. L'un se trouve dans la collection et m'avait tout d'abord échappé ; les autres proviennent de Marutea (G. Seurat, Coll. du Muséum). La comparaison minutieuse de ces divers spécimens m'amène aujourd'hui à reconnaître dans le genre *Arete*,—indépendamment de l'*A. Borradailei*,—3 espèces distinctes.

Il se trouve en effet que les spécimens provenant de Marutea sont différents d'une part de l'*Arete Indicus*, comme je l'ai montré dans une note récente (*Bull. Mus. Paris*, No. 2, p. 58, 1904), mais aussi de l'*Arete dorsalis Pacificus*, aux exemplaires de laquelle ils ressemblent beaucoup,

mais dont ils s'éloignent par la forme du rostre, surtout par la brièveté et la robustesse de tous les péréiopodes.

Cette espèce, d'après les observations de M. G. Seurat, naturaliste à Rikitea, vit en commensale parmi les piquants de la face orale d'*Heterocentrotus mamillatus* Klein, comme l'*Arete Indicus* sur *Echinometra lucunter* Gray. Je propose de la nommer *Arete Maruteensis.*

Ces deux formes une fois séparées, surtout la seconde, les exemplaires que j'ai nommés *Arete dorsalis Pacificus*, se rapportent très suffisamment à la diagnose de Stimpson pour qu'ils puissent conserver le nom *Arete dorsalis* Stimpson.

Chez l'*Arete Indicus*, le rostre est le plus souvent aussi long que le pédoncule antennulaire, 3 fois aussi long que large à la base, l'épine latérale extra-cornéenne est plus longue que le diamètre antero-postérieur de la cornée. L'article antennulaire distal est au moins 2 fois aussi long que l'article médian. Le fouet antennulaire externe comprend 6 articles avant de se bifurquer (fig. 134 *a*, *b*).

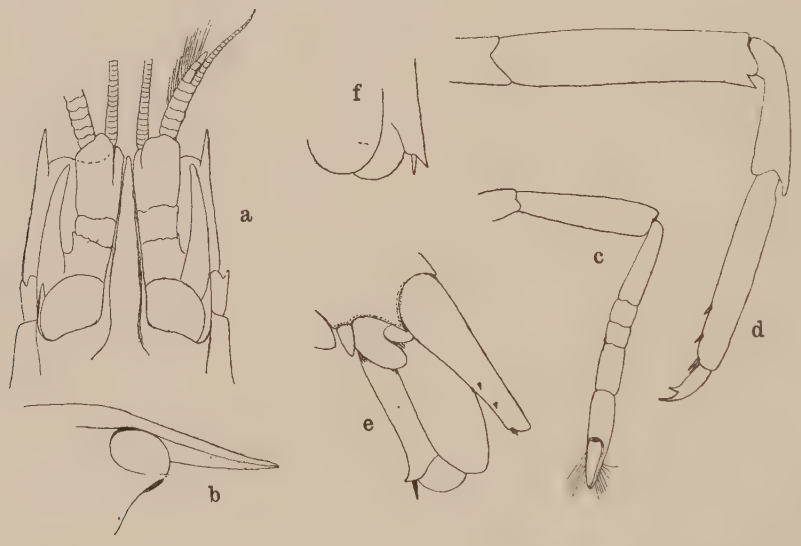


Fig. 134. *Arete Indicus* H. C. *a.* spécimen ♂, ×25; *b.* spécimen ♂ vu latéralement, ×25; *c.* patte de la 2me paire, ×25; *d.* patte de la 3me paire, ×25; *e.* telson et uropodes, ×25; *f.* telson et uropodes (spécimen ♀ d'Amérique Centrale), ×25.

L'épine latérale du scaphocérite est aigüe et longue, le carpocérite est 3 fois aussi long que large, et ne dépasse pas en longueur le pédoncule antennulaire. Les pattes de la 1e paire sont différentes chez le ♂ et la ♀. Chez le ♂, elles sont en outre asymétriques, comme dimensions et forme. Sur la plus grande, la pince est 2 fois ½ aussi longue que les doigts, un peu plus de 2 fois aussi longue que haute. Le doigt mobile est conique, régulièrement courbé; le doigt fixe, fortement incurvé vers le bas, porte au milieu de sa longueur un processus volumineux, dirigé en avant et en haut, conique, mousse (fig. 135 *a*). Lorsque la pince est fermée, les doigts laissent entre eux un large intervalle. La paume présente une dépression très nette du bord externe, près de l'articulation du carpe. Celui-ci, vu du côté inféro-externe, se montre avec le bord sinueux, à peine échancré vers le milieu de sa hauteur. Vu du côté interne, il est très élargi distalement pour embrasser l'extrémité palmaire, mais s'atténue

beaucoup du côté proximal, où sa face inférieure reçoit l'extrémité du méropodite. Le bord inférieur se montre ainsi courbé en S très ouvert (fig. 135 *c*).

Le méropodite est plus long que large (rapport 1·4); l'ischiopodite, plus large que long, très court, porte 3 tubercules épineux, 2 dorsaux, 1 ventral.

La pince opposée a les doigts très obliques vers le bas, de sorte que le rapport entre la longueur totale et celle des doigts est égal à 2 ou à 2·55 suivant qu'on mesure respectivement la longueur des doigts suivant leur axe propre, ou suivant l'axe de la paume. Le rapport de la longueur à la hauteur est un peu supérieur à 2.

Le doigt mobile a la même forme que sur la pince opposée. Sur le doigt fixe, au contraire, le lobe isolé est remplacé par une crête dentelée, de sorte que les doigts ne laissent plus d'intervalle entre eux quand la pince est fermée (fig. 135 *b*).

Chez les ♀, les 2 pinces sont peu asymétriques, semblables l'une et l'autre comme armature à la plus petite du ♂ et au plus égale à celle-ci comme dimensions.

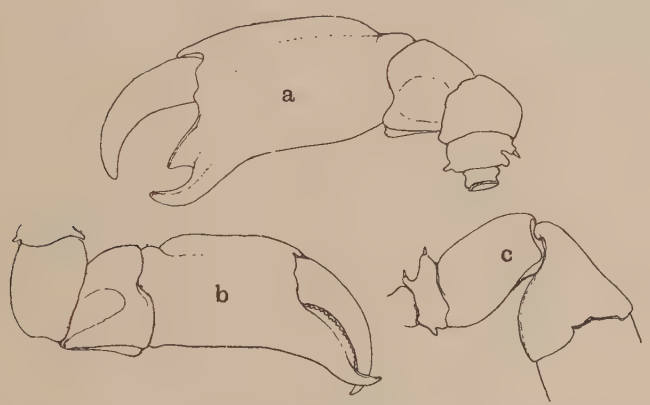


Fig. 135. *Arete Indicus* H. C. *a.* première paire, grande pince, ×12; *b.* première paire, petite pince, ×12; *c.* première paire, carpe et méropodite, vus en dehors, spécimen ♂ de Djibouti, ×12.

Les pattes 3 et 4 ont le méropodite cylindrique, 4 fois ½ aussi long que large, et portant une forte épine à son apex inférieur distal. Le propodite est 1 fois ½ aussi long que le carpe, le premier à peu près inerme, sauf 2—3 spinules, le second entièrement lisse. Le dactyle est nettement bifide, la griffe surnuméraire ventrale un peu plus courte que la principale (fig. 134 *d*).

Le telson est allongé, assez atténué à son extrémité.

Les 2 paires d'épines de la face supérieure sont très faibles,—de même que celles du bord postérieur,—et situées dans la moitié distale du telson.

Le sympodite des uropodes est arrondi et inerme, le bord de la rame externe est incurvé en dehors, un peu avant l'insertion de l'épine suturale, de sorte que la saillie aigüe de ce bord est dirigée vers l'extérieur au lieu d'être dans le prolongement du bord (fig. 134 *e*).

Hulule Male Atoll, 1 ex. ♂.

L'espèce se rencontre aussi à Djibouti (H. Coutière). Un exemplaire ♀ provenant de l'Amérique centrale (sans indication de versant) doit aussi être rapporté à cette espèce, bien que le caractère de la rame externe de l'uropode soit très atténué (fig. 134 *f*). (Coll. du Muséum.)

8. *Arete dorsalis* Stimpson (figs. 136, 137).

Arete dorsalis Stimpson, *Proc. Ac. Philad.* 1860.

Arete dorsalis Pacificus H. Coutière, *Bull. Soc. Philom.* 9. v. p. 17, 1903.

Le rostre ne s'étend plus, dans cette espèce, que jusqu'à l'extrémité du second article antennulaire, il est de plus très élargi à la base, à bords légèrement convexes et profondément sillonnés. Le rapport de sa longueur à la largeur de sa base est 1·3 environ (fig. 136 *a*).

L'épine extra-cornéenne latérale ne s'étend que jusqu'à la moitié du diamètre cornéen antéro-postérieur (fig. 137 *a*).

L'article antennulaire distal est 1 fois $\frac{1}{2}$ seulement aussi long que l'article médian, le fouet externe porte 12 et jusqu'à 17 articles avant de se bifurquer. (Sur un ex. ♂ des Maldives, le fouet de gauche porte 10, celui de droite 12 articles.) (Figs. 136, 137 *a*.)

Les caractères du stylo- et du scaphocérite sont à peu près ceux de l'*A. Indicus*, l'un et l'autre se terminant toutefois en pointe plus forte et plus émoussée.

Le carpocérite dépasse un peu l'extrémité du pédoncule antennulaire, il est cylindrique et très massif, un peu plus de 2 fois aussi long que large (fig. 137 *a*).

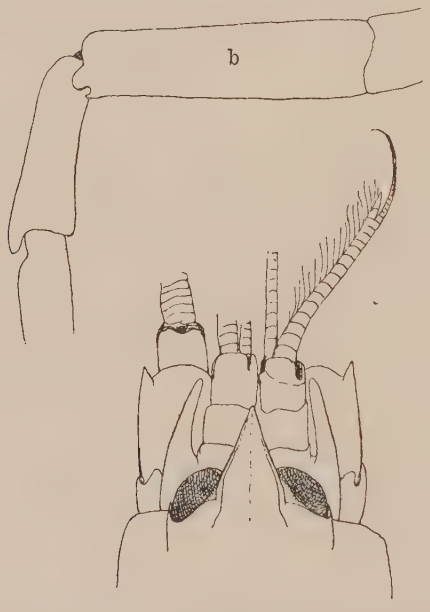


Fig. 136. *Arete dorsalis* Stimpson. *a*. spécimen ♂ de Samoa, très adulte, ×12; *b*. spécimen ♂, patte de la 3me paire, ×30.

Les pattes de la 1re paire ne sont connues jusqu'à présent que par la plus petite, chez le ♂. Il est à présumer toutefois que ces pinces sont asymétriques, et plus voisines comme forme de l'*A. Maruteensis* que de l'*A. Indicus* (fig. 137 *b*). Les doigts sont courbés, et leur axe oblique vis à vis de la paume. Mesurés suivant cet axe propre, ils sont à peu près aussi longs que la portion palmaire. Le doigt mobile est conique, courbé plus fortement à la pointe. Le doigt fixe porte, comme armature, un lobe denté, à angle antérieur droit, s'étendant sur les $\frac{2}{3}$ des doigts, et une saillie obtuse située un peu en arrière du point où vient croiser

le dactyle. La paume est 1 fois $\frac{1}{2}$ aussi longue que haute, elle porte une constriction transversale très près de l'articulation du carpe, sur le bord supéro-externe, et une "linea impressa" semblable à celle que l'on remarque dans la plupart des espèces de *Synalpheus* et d'*Alpheus*.

Le carpe montre, du côté inféro-externe, une échancrure très marquée, dont le bord inférieur est en pointe assez aigüe, et qui marque l'extrémité d'une dépression recevant au repos le méropodite. Le carpe est plus large que long, et son bord interne en forme d'S, dont les deux courbures sont très inégales.

Le méropodite est à peu près 2 fois aussi long que large, cylindrique sauf sur la face inférieure, dont les bords sont sinués. L'ischiopodite est plus large que long, avec ses bords inférieur et supérieur terminés en épine (fig. 137 *b*).

Sur la 2^{me} paire, le 1er article est aussi long que la somme des 3 autres, le 3^{me} est le plus court, le 4^{me} égal à la somme des 2 précédents (fig. 137 *c*). La pince est aussi longue que les segments 3 et 4 réunis. Chez l'*A. Indicus* le 1er segment est à peine égal à la somme des 3 autres, la pince plus longue que les segments 2, 3, 4, réunis (fig. 134 *c*).

Le méropodite de la 3^{me} paire est cylindrique, le rapport de sa longueur à sa largeur est 3·7 environ. Il porte à son apex inférieur distal une très faible dent épineuse, prolongeant simplement le bord inférieur rectiligne et peu visible (fig. 136 *b*). Le carpe est inerme, le propodite porte une douzaine de petites spinules. Le dactyle est bifide, comme chez l'*A. Indicus*.

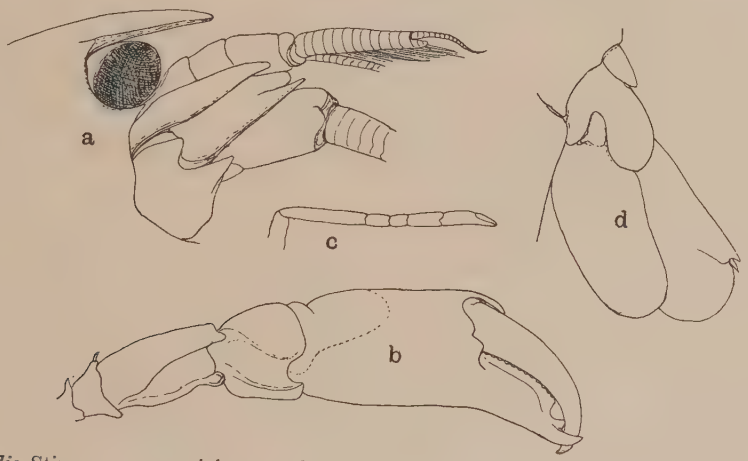


Fig. 137. *Arete dorsalis* Stimpson. *a*. spécimen ♂ de Goidu vu latéralement, ×20; *b*. spécimen ♂, petite pince de la 1re paire, ×12; *c*. carpe de la 2^{me} paire, ×12; *d*. telson et uropodes, ×30.

Le telson a la même forme que dans cette espèce, le rapport de la longueur totale à la largeur du bord postérieur est 3·5, le rapport des deux bords, antérieur et postérieur, 2·66 environ. Le bord de l'uropode (rame externe) est droit, et l'épine suturale dans son prolongement (fig. 137 *d*).

La diagnose de Stimpson s'accorde très bien avec la description précédente en ce qui concerne les détails du rostre, des antennes, des 2^{me} et 3^{me} paires. Stimpson indique, pour les pattes de la 1re paire, des pinces deux fois plus longues que larges, dont les doigts sont denticulés et joints, plus courts d'$\frac{1}{3}$ que la paume. Il est probable que les doigts joignent à peu près exactement chez les ♀, comme chez l'*A. Indicus*, et que c'est un spécimen de ce sexe qui constitue le type de Stimpson. Quant à l'apiculation du méropodite, elle est

si peu marquée qu'elle a très bien pu échapper à Stimpson, comme elle m'avait échappé tout d'abord.

L'*A. Maruteensis* a le rostre de forme un peu différente, plus rétréci à la base, avec des traces de denticules supra-cornéens. Les pinces sont asymétriques chez les ♀, assez semblables comme forme, dans ce sexe, à celles du ♂ chez l'*A. Indicus*, mais plus courtes et plus trapues. Chez le ♂, je ne saurais dire s'il y a asymétrie, les grandes pinces que j'ai pu examiner sont très fortes, massives, la paume à peine plus longue que haute. L'armature du doigt fixe rappelle celle que l'on remarque chez l'*A. dorsalis*, mais le lobe denté est plus réduit, et l'intervalle semi-circulaire entre les doigts augmenté d'autant, entre son bord antérieur et la saillie distale du doigt fixe.

La 2^{me} paire est très courte, le 1er segment est plus court que la somme des 3 autres, le 4^{me} plus court aussi que la somme des segments 2 et 3, la pince terminale aussi longue que les segments 1, 2, 3 réunis.

Les pattes 3 et 4 sont beaucoup plus robustes que chez l'*A. dorsalis*. Le méropodite n'est plus du tout épineux, son bord inférieur externe est coupé à angle droit à son extrémité distale de façon à former comme une aile transparente vis à vis du bord interne, mais sans épine ni saillie visible. Le rapport de sa longueur à sa largeur est seulement 3·8. Le carpe a les $\frac{3}{5}$ du méropodite, le propodite les $\frac{8}{9}$ de ce dernier article; il est seulement 4 fois aussi long que large et porte 12—14 fines spinules. Le dactyle est fortement bifide, la griffe ventrale presque aussi longue que la principale.

Nous ne possédons aucun renseignement biologique sur l'*Arete dorsalis*. Il est possible que l'espèce vive réellement "inter rupes littorales" comme le dit Stimpson, il se peut aussi qu'elle soit, comme les deux autres, commensale des Oursins, ce commensalisme pouvant facilement être méconnu par suite de la facilité avec laquelle l'Alpheidé abandonne le couvert des piquants.

Goidu Atoll, 1 ex. ♂.

L'espèce se trouve aussi à Samoa, en N^{lle} Calédonie (Coll. du Muséum). Le type provient de Hong-Kong.

Il est impossible de dire de laquelle des espèces du genre *Arete* est synonyme l'*Athanas Mascarenicus* Richters. L'espèce décrite par de Man (*Arch. f. Naturg.* 1. p. 532, 1887) et provenant de Nordwachter Inseln est probablement différente encore des 3 précédentes, d'après les proportions données par l'auteur pour les pinces de la 1re paire.

Genre *Alpheopsis* H. Coutière.

9—10. *Alpheopsis equalis* H. Coutière (fig. 138) et var. *truncatus*, n. (fig. 139).

L'*Alpheopsis equalis* est représenté dans la collection des Laquedives et Maldives par trois spécimens, présentant entre eux de légères différences.

L'un d'eux (fig. 138 *a*, *b*) est tout-à-fait semblable aux représentants de l'espèce provenant de la mer Rouge et du Pacifique (Collections du Muséum); les deux autres en diffèrent par la forme du rostre et quelques autres points.

Au lieu d'affecter la forme d'une pointe triangulaire étroite, carénée inférieurement, le rostre est tronqué très près de sa base, et la carène inférieure est elle-même coupée oblique-

ment de haut en bas (fig. 139 *a*, *b*). Il serait singulier qu'il s'agît d'une malformation, les deux spécimens, un ♂ et une ♀, présentant l'un et l'autre ce caractère.

Les pédoncules antennulaires sont plus larges et plus courts, de même que l'écaille antennaire.

Fig. 138. *Alpheopsis equalis* H. C. *a*. spécimen ♂ (type), ×25; *b*. spécimen ♂ vu latéralement, ×25.

Les pinces de la première paire, qui sont présentes sur le spécimen ♀, sont plus ovoïdes que chez l'*Alpheopsis equalis* type, les doigts sont plus étroits et légèrement plus longs (fig. 139 *b*).

Il me paraît nécessaire de distinguer provisoirement ces spécimens sous le nom de la var. *truncatus*. L'extrême rareté d'*Alpheopsis equalis* ne permet pas actuellement de séparer ces deux formes de façon plus complète.

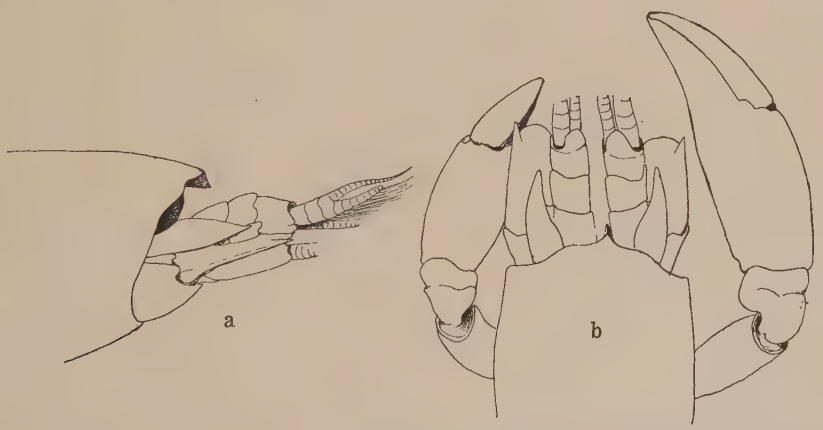


Fig. 139. *A. equalis* var. *truncatus* H. C. *a*. spécimen ♂ (type), ×25; *b*. spécimen ♂ vu latéralement, ×25.

Alpheopsis equalis H. C. North Male Atoll, 1 sp. ♂. L'espèce se trouve aussi en Nouvelle-Calédonie (M. de Bausaq), Perim (Dr. Jousseaume), Djibouti (H. Coutière), *A. equalis* var. *truncatus* H. C. Goifufahendu Atoll, 2 sp. ♂ et ♀.

Genre *Synalpheus* Sp. Bate.

11. *Synalpheus neomeris* de Man (Pl. LXX. fig. 1).

S. neomeris de Man, *Zool. Jahrb.* 9 Bd. p. 734, pl. 35, fig. 61, 1897.

North Male Atoll; Naifaro Reef; Suvadiva Atoll; Mulaku Atoll; Miladumadulu Atoll;

Felidu Atoll; Addu Atoll; Mahlos Atoll; South Nilandu Atoll; Kolumadulu Atoll; Haddumati Atoll; 38 ex. ♂ et ♀.

S. neomeris a été trouvé également dans la mer Rouge, le golfe du Bengale (Rameswaran, Arch. Mergui), à Madagascar, en Australie, en Malaisie, au Japon, aux îles Fiji.

12. *Synalpheus neomeris* var. *streptodactylus* n. (Pl. LXX. fig. 1′).

Les exemplaires de cette variété diffèrent du *S. neomeris* typique par les péréiopodes 3, 4, 5 légèrement plus grêles et plus allongés, et surtout par la forme du dactyle. Chez le *S. neomeris*, la griffe dorsale, à sa base, n'a pas plus du tiers de l'épaisseur de la griffe principale, avec une longueur moitié moindre. Dans la variété *streptodactylus*, la griffe accessoire a la moitié de l'épaisseur de la griffe principale, et les $\frac{2}{3}$ au moins de sa longueur. Le dactyle tout entier est plus effilé à son extrémité distale, ses bords convergeant au lieu d'être parallèles.

Haddumati Atoll; Suvadiva Atoll; South Nilandu Atoll 5 ex. ♂ et ♀. Les 3 exemplaires provenant de cette dernière station sont d'un rouge-brun intense (dans l'alcool) sauf l'écaille du scaphocérite, les exopodites des pièces buccales, les branchies, et toutes les articulations, qui étaient incolores ou se sont décolorées.

Cette variété paraît avoir été rencontrée par de Man parmi des exemplaires jeunes d'Atjeh. (De Man, l.c. p. 738, fig. 61 c.)

13. *Synalpheus Gravieri* n. sp. (Pl. LXX. fig. 2).

Je crois nécessaire de distinguer sous ce nom un certain nombre de spécimens très voisins du *S. neomeris*, mais qui s'en distinguent par quelques caractères très nets.

Les deux épines orbitaires sont fréquemment plus divergentes que chez le *S. neomeris*. Le stylocérite ne dépasse guère l'extrémité de l'article antennulaire basal. L'épine inférieure du basicérite est plus courte que le stylocérite. L'épine latérale du scaphocérite est plus courte que le carpocérite, et ne dépasse pas en longueur le pédoncule antennulaire. L'écaille du scaphocérite est plus large que chez le *S. neomeris* (fig. 2).

La petite pince de la 1re paire a les doigts un peu plus longs que chez le *S. neomeris*, et la paume un peu moins épaisse. Le rapport de la pince entière à la hauteur de la paume est 3·75 environ, au lieu de 3·25 chez le *S. neomeris* (fig. 2 *a*).

Les péréiopodes 3, 4 et 5 sont un peu différents comme proportions. Chez le *S. neomeris*, le méro- et le propodite de la 3me paire sont sensiblement égaux, ou le propodite légèrement plus long. Chez le *S. Gravieri*, le propodite est plus court. Les proportions relatives du méro-, du carpo- et du propodite sont les suivantes, pour la 3me paire;

S. neomeris: 42, 15, 42·5 }
S. Gravieri: 45, 16, 39 } %

la somme des 3 articles étant représentée par 100 (fig. 2 *b*).

Chez le *S. neomeris* la 4me paire est généralement la plus courte, la différence portant surtout sur le carpe, notablement plus court que sur la 5me paire, où il est d'ailleurs le plus long. Chez le *S. Gravieri*, la 5me paire n'est pas plus longue que la 4me, par suite de la brièveté plus grande du carpe:

	4me paire.		5me paire.	
S. neomeris:	40·5, 16, 43·5 } %		34, 24, 42 } %	
S. Gravieri:	41, 17, 41 } %		36, 21, 43 } %	

Il résulte de la brièveté des propodites des 3me et 4me paires chez le *S. Gravieri* une apparence plus trapue de ces membres, dont l'armature épineuse est d'ailleurs la même que chez le *S. neomeris*.

Le dactyle est aussi de forme différente, et caractérisé surtout par la réduction de la griffe dorsale, très grêle, n'ayant guère que $\frac{1}{6}$ de l'épaisseur et $\frac{1}{3}$ de la longueur de la griffe principale. Celle-ci est coudée plus brusquement que chez le *S. neomeris* (fig. 2 *b'*).

La forme du telson et des uropodes est la même que chez le *S. neomeris* (fig. 2 *c*).

Fadifolu Atoll, Miladumadulu Atoll, South Nilandu Atoll, North Male Atoll 14 ex. ♂ et ♀. (2 ex. de cette dernière station sont restés colorés en rouge clair dans l'alcool.)

L'espèce se trouve également dans la mer Rouge (Djibouti, Ch. Gravier) et dans la "mer de Chine" (Bougainville).

Parmi les spécimens du *S. neomeris*, j'ai rencontré un ♂ remarquable par le mélange qu'il présente des caractères de cette espèce et du *S. Bougainvillei*. Peut-être s'agit-il d'un hybride de ces deux formes. Le rostre, les épines orbitaires, le stylocérite, l'épine du scaphocérite, aussi longue que le carpocérite et même le dépassant, sont semblables à leurs homologues chez le *S. neomeris*. D'autre part, les pattes de la 3me paire ont le propodite court et l'apparence trapue, les dactylopodites des pattes 3, 4, 5 sont absolument semblables à ceux du *S. Bougainvillei* (Pl. LXX. fig. 3, 3 *a*).

North Male Atoll, 1 ex. ♂.

14. *Synalpheus Nilandensis* n. sp. (Pl. LXX. fig. 4).

Cette espèce est très voisine aussi du *S. neomeris*. Le rostre et les épines orbitaires sont égaux, généralement récurvés vers le haut, peu divergents. Le stylocérite ne dépasse guère l'extrémité de l'article basal antennulaire; le basicérite a son épine supérieure forte, égale aux $\frac{3}{4}$ de l'épine inférieure, celle-ci étant plus courte que le stylocérite. Comme chez le *S. neomeris*, l'épine du scaphocérite atteint aussi loin en avant que le carpocérite (fig. 4).

La 1re et la 2me paire de pattes comme chez le *S. neomeris* (fig. 4 *a*, *b*). Les pattes de la 3me paire offrent des proportions à peu près exactement comparables à celles du *S. Bougainvillei* (44, 17·5, 39·5 %). Celles de la 4me paire ont le propodite plus petit que le mérus (44, 16, 40 %); le propodite est au contraire légèrement plus long sur la 5me paire (38, 25, 39 %). L'armature épineuse du méro- et du propodite est la même que chez les espèces précédentes. Il y a toutefois fréquemment 5 épines sur le méropodite de la 3me paire (fig. 4 *c*).

Le dactylopodite est triunguiculé; la griffe principale, médiane, et la griffe accessoire dorsale sont sensiblement disposées comme chez le *S. Bougainvillei*, la griffe principale étant toutefois presque perpendiculaire à l'axe du dactyle, et l'accessoire très réduite. La 3me griffe est ventrale, sa pointe est dirigée en avant, de telle sorte que les bords inférieur et supérieur du dactyle sont parallèles à ce niveau (fig. 4 *c'*).

Le telson, comme dans les espèces précédentes, a ses angles postérieurs aigus et son bord libre arrondi, entre deux paires d'épines dont l'intérieure est la plus longue (fig. 4 *d*).

North Male Atoll, Suvadiva Atoll, South Male Atoll, South Nilandu Atoll, 5 ex. ♂ and ♀. Trois d'entre eux ont été capturés, soit sur des Gorgonidae, soit sur *Solenocaulon*.

15. *Synalpheus Nilandensis*, var. *oxyceros* n. (Pl. LXX. fig. 5).

Un des spécimens du *S. Nilandensis* se distingue nettement des 5 autres par plusieurs caractères, qui m'ont fait le séparer sous le nom de var. *oxyceros*. Le stylocérite s'étend

jusqu'au milieu de l'article antennulaire médian, l'épine inférieure du basicérite jusqu'à l'extrémité du même article. L'épine latérale du scaphocérite, très longue, dépasse l'extrémité du carpocérite d'une fois et demie la longueur de l'article antennulaire distal. De plus, la forme du dactyle, sur les pattes 3, 4, 5 n'est pas celle des exemplaires typiques. La griffe dorsale est plus forte, les deux autres moins accentuées, le dactyle entier est plus grêle et moins large (fig. 5 *a*).

South Nilandu Atoll, 1 ex. ♀.

16. *Synalpheus fossor* Paulson (Pl. LXX. fig. 6).

S. fossor Paulson, *Recherches sur les Crust. de la mer Rouge* (*en russe*), p. 103, pl. 13, fig. 5, 1875.

Cette belle espèce n'avait pas été revue depuis Paulson. La description et la figure de celui-ci permettent une détermination facile, mais il est inexact que le dactyle des pattes 3, 4, 5 soit fortement concave sur une face comme le dit Paulson. Il est aplati, avec le dos épais et convexe, et rappelle de très près celui du *S. Nilandensis*. La griffe accessoire dorsale est seulement plus forte et se raccorde par un arc de cercle à la griffe principale, au lieu de le rejoindre sous un angle aigu (fig. 6 *a*). Les méropodites 3 et 4 sont dépourvus d'épines.

Reef Naifaro, 2 ex. ♂ et ♀.

17. *Synalpheus paraneomeris* n. sp. (Pl. LXXI. fig. 7).

J'ai fait allusion à cette espèce, sans la décrire, dans un travail antérieur sur les Alpheidae (*Ann. Sc. nat.* (6) p. 456, 501). Elle diffère du *S. neomeris* surtout par l'absence d'épines mérales, comme le *S. fossor* diffère du *S. Nilandensis*.

Le rostre et les épines orbitaires sont de longueur très variables, celui-là toujours un peu plus long, celles-ci obtuses ou aigües, en forme de triangle à côtés courbes; les uns et les autres ne dépassent pas l'extrémité de l'article basal antennulaire, mais peuvent s'étendre seulement jusqu'à la moitié de cette longueur (fig. 7, 7').

Le stylocérite s'étend jusqu'à la moitié au moins de l'article antennulaire médian, parfois aussi jusqu'à l'extrémité de cet article, ou presque. L'écaille du scaphocérite est de largeur assez variable; elle s'étend en avant jusqu'à la moitié ou au tiers distal du 3^{me} article antennulaire. L'épine latérale du scaphocérite est forte, et aussi longue que le carpocérite, ou légèrement plus courte. Elle dépasse le pédoncule antennulaire de la moitié environ de l'article distal, lequel est aussi long que l'article médian.

Le basicérite n'est pas épineux à son angle supérieur, qui est droit. Il se prolonge inférieurement en une longue épine, égale au stylocérite.

La grande pince de la 1re paire n'a pas de tubercule épineux terminant le bord supérieur palmaire; les doigts sont à la pince entière dans le rapport de 3 à 3·5, et à peu près égaux à la hauteur de la paume, mesurée dans le plan des doigts. Le méropodite de la grande pince est marqué d'une constriction assez profonde près de son extrémité distale, qui est obtuse et non épineuse (fig. 7 *a*).

La petite pince est 2 fois $\frac{1}{2}$ à 3 fois plus petite que son opposée, le rapport des doigts à la pince entière varie de 2·3 à 2·7 (fig. 7 *b*).

Le carpe de la 2me paire de pattes a le segment proximal un peu plus long que la somme des 4 autres, le segment distal égal à la somme des segments 2 et 3, ce dernier étant le plus long des deux (fig. 7 *c*).

Le méropodite de la 3me paire est inerme, égal au propodite ou très légèrement plus long. La 5me paire est un peu plus longue que la 4me, surtout au point de vue du carpe. Le propodite de la 3me paire porte 5–6 spinules, il est à 8 fois aussi long que large, le méropodite 4 fois ½. Le dactyle a sa griffe principale ventrale, courbe, obtuse, suivie d'une concavité du bord inférieur parfois assez marquée pour indiquer une ébauche de triunguiculation. La griffe accessoire est aussi longue que la précédente, environ 2 fois moins épaisse à la base (fig. 7 *d*, *d'*, *d''*).

Le telson a ses angles postérieurs arrondis, marqués seulement par l'insertion des 2 paires postérieures d'épines. Son bord postérieur arrondi porte 13 soies plumeuses (fig. 7 *e*). Le sympodite des uropodes est muni de 2 épines égales. Malgré un nombre assez grand de spécimens, je n'ai pu arriver à établir des variétés bien caractérisées dans cette espèce. Il semble toutefois qu'il y ait une certaine corrélation entre la longueur du rostre, des épines orbitaires, et celle du basi- et du scaphocérite. Mais les variations de forme du dactyle, dont l'importance est toujours grande chez *Synalpheus*, ne m'ont pas paru se produire parallèlement.

Goidu Atoll, Minikoi, 14 ex. ♂ et ♀.

L'espèce se trouve également à Djibouti (H. Coutière), Mascate (M. Maindron), Mahé (M. Alluaud).

18. *Synalpheus Charon* Heller.

S. Charon Heller, *Sitzungsber. Akad. Wien*, Bd. 44, 1, p. 272, pl. 3 fig. 21—22.

South Nilandu Atoll, Naifaro Reef, Hulule Male Atoll, Goidu Atoll, 15 ex. ♂ et ♀.

19. *Synalpheus biunguiculatus* Stimpson? de Man (Pl. LXXI. fig. 8).

S. biunguiculatus Stimpson, *Proc. Acad. Philad.* p. 31, 1860.

„ Stimpson, de Man, *Arch. f. Naturg.* p. 502, 1887.

„ Stimpson, de Man, H. Coutière, *Bull. Soc. Entom.* No. 11, p. 232, 1898.

Cette importante espèce se relie aux précédentes par la forme des dactylopodites 3, 4, 5, dans lesquels la griffe ventrale est très légèrement plus forte que celle du côté dorsal. Elle passe insensiblement à un premier groupe d'espèces chez lesquelles on voit les 2 griffes du dactyle devenir égales, et même prédominer celle du côté dorsal (*Syn. tumido-manus* Paulson et formes alliées), mais elle se rattache aussi aux espèces telles que le *S. loevimanus* Heller, caractérisées surtout par la réduction de l'écaille antennaire, alors que s'accroissent les épines du scapho- et du basicérite. Le prolongement inférieur du rostre allant à la rencontre du bec ocellaire, présent chez le *S. biunguiculatus*, a disparu déjà, non seulement chez le *S. loevimanus* et les formes alliées, mais dans l'espèce nouvelle *S. Pescadorensis*, décrite un peu plus loin et très voisine cependant du *S. biunguiculatus*.

Cette dernière espèce est représentée dans la collection des Maldives et Laquedives par 2 exemplaires absolument typiques (Hulule Male Atoll); il s'y trouve en outre des formes encore inédites, dont je crois devoir faire de simples variétés.

20. *Syn. biunguiculatus*, var. *pachymeris* n. (Pl. LXXI. fig. 9).

Cette forme diffère du type par la forme des épines orbitaires et du rostre, plus courts et plus obtus, les épines notamment, en forme de larges lobes arrondis (fig. 9).

Un autre caractère est tiré des pattes 3, 4, 5. Sur la 3me paire, le rapport du méro- au propodite est de 1·64 environ, alors que chez les exemplaires typiques il n'est pas supérieur à 1·4. De plus, le méropodite est très aplati, de forme losangique, le propodite atténué à son extrémité, le dactyle petit. La griffe ventrale de celui-ci est presque perpendiculaire au bord inférieur, et suivie d'une concavité très nette de ce bord (fig. 9 *a*, *a'*). Sur la plupart des spécimens, le méropodite porte en outre 3 à 6 très fines et longues spinules sur son bord inféro-interne. Elles ne sont pas toujours présentes, qu'elles aient disparu par suite de leur fragilité, ou qu'elles ne se soient pas montrées. La spinulation des méropodites, très générale chez les Hippolytidae, encore présente chez les formes de *Synalpheus* qui s'en montrent, de ce fait, le plus voisines (*S. neomeris*, *Nilandensis*), tend de plus en plus à s'effacer chez les Alpheidae. L'irrégularité de son apparition dans la var. *pachymeris* est bien en rapport avec cette perte graduelle d'importance.

South Nilandu Atoll, 1 sp. ♀.

L'espèce se trouve également à Djibouti (H. Coutière).

21. *Synalpheus biunguiculatus*, var. *exilipes* n. (Pl. LXXI. fig. 10).

Cette seconde variété est moins bien définie en ce qu'elle se compose surtout de spécimens jeunes, de petite taille. La forme et la longueur du rostre et des épines orbitaires rappellent de très près le *S. tumido-manus* ou le *S. hastilicrassus*, décrits plus loin. Mais le stylocérite plus court, l'épine inférieure du basicérite longue et forte, l'épine du scaphocérite à peu près égale au pédoncule antennulaire, le carpocérite beaucoup plus long que ce dernier, sont nettement des caractères du *S. biunguiculatus* (comp. fig. 8 et 10). Il en est de même des pinces de la 1re paire, dont la grande est seulement 2 fois ½ plus longue que la petite.

Le rapport du méro- au propodite, sur la 3me paire, est égal au plus à 1·32 et peut descendre à 1·2, de plus le méropodite est grêle, le dactyle est plus allongé que chez le *S. biunguiculatus* typique, et montre une tendance à l'égalité et au parallélisme des 2 griffes (fig. 10 *a*, *a'*, *a''* ; comp. 8 *c*, *c'*).

Haddumati Atoll, North Male Atoll, South Nilandu Atoll, 3 sp. ♂.

22. *Synalpheus laticeps* n. sp. (Pl. LXXII. fig. 11).

J'ai établi cette espèce pour 2 spécimens ♂ et ♀ de petite taille, dont les ressemblances sont étroites avec le *S. biunguiculatus* et le *S. tumido-manus*, mais qui en diffèrent cependant par quelques caractères très nets.

Le rostre et les épines orbitaires sont égaux en longueur, et rapprochés, le premier étroit, les secondes peu divergentes, en forme de triangle isocèle à base étroite. Le stylocérite, le carpo- et le basicérite comme chez le *S. biunguiculatus*, mais l'épine du scaphocérite, très longue, dépasse même légèrement le carpocérite (fig. 11).

La grande pince est absente. La petite pince a le dactyle spatulé, ovale, creusé en cuiller inférieurement et terminé en avant par 3 pointes courtes et larges. Le " pollex " est également excavé sur sa moitié distale, surtout sur le côté externe où le bord est mince et tranchant, et se termine par deux dents, alternant avec celles du dactyle (fig. 11 *a*, *a'*, *a''*). Sur la 2me paire, le 1er segment (proximal) du carpe est égal à 2 fois le 5me. Les segments 2, 3, 4 sont sensiblement égaux (fig. 11 *b*).

Sur la 3me paire, le méropodite est plus grand que le propodite, celui-ci est un peu plus de 2 fois aussi long que le carpe. Le dactylopodite a ses deux griffes parallèles et un peu inégales, la griffe dorsale étant plus longue et plus grêle que la griffe ventrale (fig. 11 *c*, *c'*).

Le telson a ses angles postérieurs aigus, et le bord postérieur est semi-circulaire, entre les 2 paires d'épines habituelles. Il porte 7 soies sur les spécimens que j'ai examinés (fig. 11 *d*).

North Male Atoll, 3 sp. ♂ et ♀.

23. *Synalpheus hastilicrassus* n. sp. (Pl. LXXII. fig. 12).

Le rostre est toujours notablement plus long que les épines orbitaires et peut atteindre jusqu'à la moitié de l'article antennulaire médian. Le stylocérite et l'épine inférieure du basicérite sont presque égaux en longueur, le premier toutefois un peu plus long, contrairement à ce qui a lieu dans les espèces précédentes, alliées au *S. biunguiculatus*. L'épine du scaphocérite est le plus souvent égale en longueur au carpocérite, qui dépasse le pédoncule antennulaire de la moitié de l'article distal de celui-ci (fig. 12).

Le basicérite, comme chez le *S. paraneomeris*, est tout à fait dépourvu d'épine à son angle supérieur. Le carpocérite est épais et renflé en son milieu, de telle sorte qu'il est au plus 4 fois aussi long que large, ce rapport pouvant même descendre à 3·5 et 3·2. Chez le *S. biunguiculatus*, chez le *S. tumido-manus*, espèce également très voisine, ce rapport est toujours supérieur à 4 et atteint d'ordinaire 4·5 (fig. 12′).

La grande pince est semblable, comme forme et proportions, à celle du *S. tumido-manus*, mais le méropodite n'est pas épineux à l'extrémité distale de son bord supérieur (fig. 12 *a*, *a*′). La petite pince est semblable à celle du *S. biunguiculatus*, elle est plus longue que son méropodite, dans la proportion de 5 à 4, et elle est environ 2 fois $\frac{1}{2}$ plus petite que la pince opposée (fig. 12 *b*).

Sur la 2^{me} paire, le 1er segment (proximal) du carpe est plus long que la somme des 4 autres, qui égale la pince en longueur. Le segment 2 est plus long que le 3^{me}, lequel est égal au 4^{me}.

Les proportions de la 3^{me} paire rappellent celles rencontrées dans la variété *exilipes* du *S. biunguiculatus*, et celles aussi qui existent chez les *S. laticeps*, *S. tumido-manus*; le méropodite est plus long que le propodite (rapport 1·2), il est un peu plus de 4 fois aussi long que large. Le propodite a un peu plus de deux fois la longueur du carpe. Il porte 9 spinules. Le méropodite est absolument inerme, comme dans les espèces précédentes (fig. 12 *c*).

Le dactylopodite, comme chez le *S. biunguiculatus exilipes*, a la griffe ventrale un peu plus forte que la griffe dorsale, et divergente, mais de même longueur (fig. 12 *c*′).

Le telson a ses angles postérieurs formant deux pointes triangulaires fortes, n'atteignant pas aussi loin toutefois que le bord semi-circulaire compris entre elles. Les 2 paires d'épines qui limitent ce bord postérieur sont longues et fortes, la paire intérieure un peu plus longue (fig. 12 *d*).

South Nilandu Atoll, North Male Atoll, Felidu Atoll, Kendikolu Reef, Miladumadulu Atoll, 10 sp. ♂ et ♀. Un ♂ provenant de South Nilandu Atoll, station 6, est de couleur rouge-brun foncé.

24. *Syn. acanthitelsonis* n. sp. (Pl. LXXII. fig. 13).

Cette espèce, très voisine de la précédente, s'en distingue par quelques points très tranchés.

Le basicérite est épineux à son angle supérieur comme dans toutes les espèces examinées, sauf la précédente et le *S. paraneomeris*. Par ce caractère, le *S. acanthitelsonis* se rapproche davantage encore du *S. tumido-manus*. Le rostre, comme chez le *S. hastilicrassus*, est générale-

ment très aigu et s'étend jusqu'au milieu de l'article antennulaire médian. Il peut même atteindre presque l'extrémité de cet article, ou être au contraire beaucoup plus court, comme dans l'exemplaire figuré (fig. 13, 13′).

Le carpocérite offre absolument les mêmes dimensions relatives que dans l'espèce *S. hastilicrassus.*

La forme des pinces de la 1re paire est également la même. Le méropodite seul diffère; inerme chez le *S. hastilicrassus,* il est armé chez le *S. acanthitelsonis* d'une épine assez forte, continuant l'arête supérieure de l'article sur la petite pince, oblique et dirigée vers le bas sur la grande pince (fig. 13 *a, b*).

Enfin, la forme du telson est un peu différente. Les angles sont fortement aigus, et les pointes qu'ils forment sont plus longues que les épines du bord postérieur. Les angles du telson s'étendent aussi plus loin que la convexité de ce bord, alors que celui-ci les dépassait légèrement chez le *S. hastilicrassus* (fig. 13 *c*).

Hulule Male Atoll, Fadifolu Atoll, Addu Atoll, Mulaku Atoll, North Male Atoll, 7 ex. ♂ et ♀.

25. *Syn. tumido-manus* Paulson (Pl. LXXIII. fig. 14).

S. tumido-manus Paulson, *Recherches sur les Crust. de la mer Rouge* (*en russe*), p. 101, pl. 13, fig. 2, 1875.

S. tumido-manus Paulson, *S. neptunus* Dana, H. Coutière, loc. cit.

J'ai cru pouvoir identifier l'espèce décrite par Paulson avec des spécimens que j'ai recueillis en grand nombre à Djibouti, vivant principalement dans les Éponges, et dont 18 exemplaires se trouvent dans la collection des Maldives et Laquedives. Mais il faut abandonner la synonymie avec le *S. neptunus* Dana, dont j'ai pu examiner les types.

Ceux-ci, provenant de Sooloo-Sea, sont deux specimens ♂ de très petite taille (longueur du céphalothorax 2 mm.); le stylocérite est plus court que l'article antennulaire basal, le scaphocérite muni d'une très étroite écaille est plus court que le pédoncule antennulaire. Le basicérite est dépourvu d'épine à son angle supérieur, et n'atteint pas tout à fait le milieu de l'article antennulaire médian. Le rostre et les épines orbitaires sont de longueur égale. La grande pince porte une forte saillie épineuse terminant le bord palmaire, les dactylopodites des paires 3 et 4 ont leur griffe ventrale plus forte. Par tous ces caractères, le *S. neptunus* se rapproche extrêmement du *S. loevimanus* Heller, dont il diffère surtout par la forme de la petite pince, le doigt mobile étant, chez le *S. neptunus,* spatulé comme chez le *S. laticeps.*

D'autre part, la figure et la description de Paulson, pour le *S. tumido-manus,* ont besoin d'être rectifiées et complétées sur quelques points.

L'épine inférieure du basicérite est plus courte que le stylocérite, lequel atteint et dépasse la moitié de l'article antennulaire médian. Le carpocérite, 4 fois $\frac{1}{2}$ plus long que large, est seulement un peu plus long que le pédoncule antennulaire, et l'épine du scaphocérite lui est égale, ou le dépasse très légèrement. Chez le *S. biunguiculatus exilipes,* qui s'en rapproche beaucoup, l'épine du basicérite est plus forte et d'ordinaire plus longue que le stylocérite, lequel ne dépasse guère l'extrémité de l'article basal antennulaire. De plus, le carpocérite est notablement plus long que le pédoncule antennulaire (fig. 14).

Il en est parfois ainsi chez le *S. tumido-manus* (jeunes spécimens), mais l'épine du scaphocérite suit alors cet allongement, au lieu de rester toujours plus courte, comme elle le fait chez le *S. biunguiculatus*.

Les pinces de la 1re paire sont caractéristiques aussi. Je crois que Paulson a exagéré la largeur de la grande pince. Cette largeur est exacte quand on mesure la paume dans le plan perpendiculaire aux doigts, mais non dans le plan de ceux-ci. Quant au réseau dont parle Paulson, il existe plus ou moins marqué sur les pinces de toutes les espèces sous forme d'insertions des faisceaux musculaires. Sur la grande pince, le rapport de la longueur totale à celle des doigts est environ 3·8, la hauteur de la paume, mesurée dans le plan des doigts, est un peu plus grande que la longueur de ceux-ci (fig. 14 *a*, *a'*).

La petite pince est environ 3 fois plus petite que la grande, c'est là un caractère très visible du *S. tumido-manus*. La pince entière est seulement un peu plus longue que le méropodite, le rapport de sa longueur à celle des doigts est 2·4 environ. Le méropodite des 2 pinces est épineux à l'extrémité distale de son bord supérieur (fig. 14 *b*).

Sur la 2me paire, le segment proximal du carpe est sensiblement égal à la somme des 4 autres, et plus long que la pince.

Sur la 3me paire, comme chez le *S. biunguiculatus exilipes*, le rapport du méro- au propodite est 1·2, et le méropodite est plus de 4 fois aussi long que large. Le dactylopodite a ses deux griffes parallèles, et très sensiblement égales comme largeur à la base. On trouve du reste, dans une série suffisante de spécimens, un passage absolument graduel entre les cas où la griffe ventrale est plus robuste, et ceux où c'est au contraire la griffe dorsale. Mais celle-ci est plus longue dans tous les cas (fig. 14 *c*, *c'*).

Le telson a ses angles postérieurs à peine marqués, le bord compris entre eux plus grand que chez le *S. biunguiculatus*, et seulement ovale, au lieu d'être semi-circulaire. Il y a sur ce point une divergence assez notable avec le dessin de Paulson, qui représente le telson semblable à celui du *S. hastilicrassus* (fig. 14 *d*).

Reef Naifaro 3 sp. ♀, Goidu, 2 sp. ♂, 1 ♀, Hulule Male Atoll, 12 sp. ♂ et ♀.

L'espèce se trouve aussi dans la mer Rouge, l'Océan Indien et le Pacifique, jusque sur la côte américaine.

26. *Synalpheus Pescadorensis* n. sp. (Pl. LXXIII. fig. 15).

Très voisine du *S. biunguiculatus* par d'importants caractères, cette espèce est le point de départ d'un autre groupe de formes, telles que les *S. loevimanus* Heller, *S. Parfaiti* H. Coutière, *S. longicarpus* Herrick, *S. minor* Say, chez lesquelles, contrairement à ce qui a lieu chez toutes les espèces précédentes, le rostre ne se prolonge pas verticalement jusqu'à la rencontre du "bec ocellaire," de façon à embrasser à droite et à gauche cette saillie et à cloisonner aussi la cavité où s'abritent les ophtalmopodes.

A part cet important détail, la région frontale rappelle la variété *pachymeris* du *S. biunguiculatus* par la brièveté du rostre et l'élargissement des épines orbitaires. Le rostre est simplement un peu épaissi en dessous, la cavité orbitaire étant entière (fig. 15).

Le stylocérite n'atteint pas l'extrémité de l'article basal antennulaire. Le basicérite est très fortement épineux, l'épine de son angle inférieur atteint presque jusqu'à la moitié de l'article antennulaire médian, celle de l'angle supérieur la moitié de la précédente. L'écaille du scaphocérite est très réduite, à peine plus longue que l'épine inférieure du basicérite. L'épine du scaphocérite, très forte, ne dépasse pas l'extrémité du pédoncule antennulaire, alors que le

carpocérite est notablement plus long, comme chez le *S. biunguiculatus*. La grande pince est celle du *S. biunguiculatus*, avec cette différence que le fort tubercule terminant le bord palmaire supérieur est ici épineux. La petite pince rappelle celle du *S. laticeps*. Elle a, comme cette dernière, les doigts lancéolés et concaves, terminés par des dents obtuses et alternes (fig. 15 *a*, *b*).

La 2me et la 3me paire comme chez le *S. biunguiculatus* var. *pachymeris*. Le méropodite est un peu plus de 3 fois aussi long que large, le rapport du méro- au propodite est de 1·6. Le propodite porte 7—8 fortes spinules, il est 4 fois ½ aussi long que large. Le dactylopodite est court, avec sa griffe ventrale à peu près égale à la dorsale en épaisseur, mais plus courte, un peu oblique par rapport au bord inférieur du dactyle (fig. 15 *c*).

Le telson est très étroit à son extrémité, de sorte que son bord postérieur est presque réduit aux insertions de ses deux volumineuses paires d'épines. Entre elles est un étroit lobe arrondi portant 5 soies. Les épines de la face supérieure sont également très fortes (fig. 15 *d*).

Le sympodite des uropodes porte une épine externe forte, atteignant comme longueur la moitié de la rame externe. Celle-ci a son bord externe marqué par deux fortes épines suturales, comprenant entre elles une épine mobile, de longueur double (fig. 15 *e*).

Miladumadulu Atoll, South Nilandu Atoll, North Male Atoll, 5 ex. ♂ et ♀.

L'espèce se trouve aussi aux Pescadores (Heurtel).

27. *Synalpheus Stimpsoni* var. *Maldivensis* n. (Pl. LXXIII. fig. 16).

Le groupe d'espèces dont font partie les *S. Stimpsoni* de Man, *S. carinatus* de Man, *S. comatularum* Hasswell, *S. Amboinæ* Zenhtner, est beaucoup plus évolué vers *Alpheus* que le reste des espèces du genre *Synalpheus*. Le méropodite des paires 3, 4, 5 est souvent épineux à son extrémité inférieure distale, le dactyle tend à n'avoir qu'une seule griffe, les maxillipèdes externes, comme chez *Alpheus*, ne sont plus épineux à l'extrémité (fig. 16 *c*), le basicérite est faiblement épineux, le scaphocérite très large.

Le spécimen pour lequel je fais la variété *Maldivensis* est extrêmement voisin du *S. Stimpsoni* de Man. Mais le rostre est très élargi et moins long, les épines orbitaires moins marquées que chez le *S. Stimpsoni* (fig. 16).

Le méropodite de la 3me paire n'a pas d'épine saillante à son bord inférieur. Ce bord se termine simplement à angle droit un peu avant l'articulation méro-carpale. La forme du dactyle est très sensiblement la même que chez le *S. Stimpsoni*, la griffe accessoire ventrale étant toutefois un peu plus grande (fig. 16 *a*, *a'*). Les pattes de la 1re paire manquent. Le telson et les uropodes ont la même forme que chez le *S. Stimpsoni* (fig. 16 *d*).

Le spécimen que j'ai examiné porte une trentaine de larves prêtes à éclore. Elles sont, comme la ♀ elle-même, d'un rouge très foncé. Ce sont des zoés, portant tous leurs appendices thoraciques; les deux premières paires ont l'endopodite cylindrique, sans traces de pinces, les pleurons abdominaux sont très marqués, les pléopodes bien distincts sous forme de bourgeons cylindriques, les uropodes non apparus encore. Le telson porte 10 soies, dont 2 très petites très près de la ligne médiane. C'est l'état auquel sont parvenues les zoés du *S. loevimanus* au moment de leur éclosion, telles que je les ai décrites dans un travail antérieur (Les Alpheidae, *l.c.*, p. 445, pl. VI., fig. 5). Mais les larves du *S. Maldivensis* sont de taille beaucoup plus forte, 4·5mm. environ au lieu de 2mm. Leurs ophtalmopodes sont plus allongés et leur telson n'a que 10 soies au lieu de 14.

Le spécimen ♀ unique du *S. Stimpsoni* var. *Maldivensis* a été recueilli à Hulule Male Atoll, en compagnie d'un Crinoïde de même couleur sur lequel il vivait vraisemblablement en commensal, à la façon du *S. comatularum*.

Genre *Alpheus* Fabr.

Groupe "megacheles" (H. Coutière, *loc. cit.*, p. 351).

28. *A. Hailstonei* n. sp. (Pl. LXXIV. fig. 18).

Cette espèce représente dans le golfe de Bengale l'*A. platydactylus* H. Coutière, de la côte occidentale d'Afrique. L'une et l'autre ont des ressemblances étroites avec l'*A. megacheles* Hailstone, dont elles diffèrent par l'allongement de la grande pince et la forme foliacée très particulière du doigt mobile.

Une autre espèce, l'*A. Talismani* H. Coutière, dérive de l'*A. ruber* M.-Edwards à peu près par les mêmes modifications de caractères, et il est remarquable de constater qu'elle est représentée aussi dans le golfe de Bengale par l'*A. macroskeles* Alcock et Anderson, très peu différente de l'*A. Talismani*. Tout se passe comme si les deux groupes d'espèces s'étaient indépendamment constitués à partir de formes communes.

Chez l'*A. Hailstonei*, le rostre est aussi long que l'article antennulaire basal, les épines orbitaires ont la moitié environ de la longueur du rostre. L'article antennulaire médian est seulement un peu plus grand que l'article basal, et n'atteint pas le double de la longueur de l'article distal. Chez l'*A. platydactylus* l'article médian est au moins 2 fois aussi long que l'article basal, et près de 4 fois aussi long que l'article distal. (Des différences de même ordre se remarquent entre l'*A. macroskeles* et l'*A. Talismani*.)

Le carpocérite est un peu plus petit que le pédoncule antennulaire au lieu d'être plus long, l'écaille du scaphocérite est aussi plus large que chez l'*A. platydactylus* (fig. 18).

La grande pince est plus grêle que chez l'*A. platydactylus*, le rapport de sa longueur à sa hauteur est 3·33 au lieu de 2·57 dans l'espèce ci-dessus, et de 2·7 chez l'*A. megacheles*.

Le doigt mobile est foliacé, contourné à sa pointe en S, sans trace de processus molaire. Il en est de même chez l'*A. platydactylus*, mais, dans cette dernière espèce le doigt fixe porte, dans le tiers proximal de sa longueur, une forte dent triangulaire, seul vestige des bords de la cavité que devrait posséder le doigt fixe, et qui a disparu en même temps que le processus molaire du doigt mobile. Chez l'*A. Hailstonei*, cette dent est représentée par un bord plus étendu, beaucoup moins procident, et qui reste du côté supérieur ou interne du doigt mobile, au lieu de faire saillie du côté inférieur ou externe. Par là, l'*A. Hailstonei* se rapproche de l'*A. megacheles* (fig. 18, 18 *a*).

L'arête supérieure du méropodite porte 3 épines mobiles, l'arête inféro-interne se termine par une forte dent épineuse.

La petite pince est semblable dans les 2 sexes, comme chez l'*A. platydactylus*, mais, comme chez l'*A. megacheles*, ♂ et ♀, le doigt mobile est légèrement foliacé sur son bord libre. Les doigts sont très légèrement plus courts que la paume, et celle-ci est 2·7 fois plus longue que haute, ce rapport devenant 2 chez l'*A. megacheles* (fig. 18 *b*).

Chez l'*A. platydactylus*, les doigts sont plus longs que la paume (rapport $\frac{10}{6}$) et portent un épais revêtement de longues soies, du côté interne surtout.

Le méropodite de la petite pince porte une rangée de 6 épines mobiles sur son bord inféro-interne, épineux en outre à son angle distal.

La 2me paire est longue et grêle, la somme du carpe et de la pince dépasse les $\frac{8}{9}$ de la longueur du céphalothorax, alors que chez l'*A. megacheles* ce rapport n'est guère que $\frac{3}{4}$. Chez l'*A. platydactylus*, la 2me paire est également grêle et allongée, mais le 1er segment du carpe est plus long.

Les paires 3 et 4 sont très grêles (fig. 18 *c*), et sensiblement de la même forme que chez l'*A. platydactylus*. Le propodite est 1 fois $\frac{1}{2}$ plus long que le carpe dans les 2 espèces, mais le méropodite est plus allongé chez l'*A. platydactylus*. L'*A. megacheles* se distingue facilement de l'une et l'autre espèce par ses pattes 3 et 4 plus robustes et plus courtes, ayant environ la longueur du céphalothorax au lieu d'être 1 fois $\frac{1}{2}$ aussi longues, et dans lesquelles le carpe a les $\frac{5}{6}$ du propodite.

North Male Atoll, Mahlos Atoll, Hulule Male Atoll, 12 ex. ♂ et ♀ (ceux provenant de la dernière station très mutilés et privés de leurs pinces).

29. *A. paradentipes* n. sp. (Pl. LXXIV. fig. 17).

Cette espèce répond à l'*A. dentipes* Guérin, de la côte occidentale d'Afrique et de la Méditerranée, comme l'*A. Hailstonei* répond à l'*A. megacheles*.

La forme du bord frontal est légèrement différent. Les épines orbitaires sont plus longues que le rostre, et se raccordent insensiblement avec le bord frontal. Elles sont plus courtes chez l'*A. dentipes*, et se raccordent à angle presque droit du côté interne avec le bord frontal (fig. 17).

L'article antennulaire médian est plus long que chacun des deux autres, alors qu'il leur est sensiblement égal chez l'*A. dentipes*. La grande pince est plus grêle, surtout dans sa portion palmaire, le rapport de la longueur à la hauteur étant 3, au lieu de 2·45 chez l'*A. dentipes*. Les constrictions des bords interne et externe sont moins accusées aussi. Le méropodite est de même forme que chez l'*A. dentipes*, mais son bord supéro-interne est 7—8 denté, au lieu d'être inerme comme chez l'*A. dentipes* (fig. 17 *a*).

La petite pince, qui présente chez l'*A. dentipes* une différence sexuelle extrêmement marquée, est semblable dans les deux sexes de la nouvelle espèce. Le doigt mobile est très légèrement élargi et tranchant sur son bord libre, et la paume ne présente qu'une constriction presque nulle en avant de l'articulation du doigt mobile (fig. 17 *b*, *b'*).

La 2me paire est tout à fait semblable dans les 2 espèces, peut-être la pince terminale est-elle un peu plus longue chez l'*A. dentipes* (fig. 17 *c*).

La 3me paire est plus grêle et plus allongée chez l'*A. paradentipes*, le rapport de sa longueur à celle du céphalothorax est environ 1·3, au lieu de 1·2 chez l'*A. dentipes*. Cet allongement porte sur tous les articles du membre, sauf le dactylopodite, qui est plus court, et dont les 2 griffes sont égales et divergentes. En outre, le méropodite est plus fortement épineux à son extrémité inférieure distale, et le carpe porte 3 épines mobiles, au lieu d'une seule présente chez l'*A. dentipes* (fig. 17 *d*).

Miladumadulu Atoll, North Male Atoll, 6 sp. ♂ et ♀.

30. *A. deuteropus* Hilgendorf.

A. deuteropus Hilgendorf, *Monatsb. K. Ak. Wiss. Berlin*, p. 839, pl. IV., fig. 8—10, 1878.

Goidu Atoll, Hulule Male Atoll, 8 ex. ♂ et ♀.

L'espèce se rencontre également à Zanzibar (Hilgendorf), à Perim, Obock, Djibouti (Jousseaume), à l'île Tague (Comm^{t} du "Lutin").

31. *A. collumianus* Stimpson.

A. collumianus Stimpson, *Proc. Acad. Philad.* p. 30, 1860, Ortmann, *Zool. Jahrb.* v. 1890.

South Nilandu Atoll, Hulule Male Atoll, Mahlos Atoll, 6 ex. ♂ et ♀.

L'espèce se rencontre également à Bonin (Stimpson), au Japon, île Kagoshima (Döderlein), à l'île Tague (Comm^{t} du "Lutin"), en N^{lle} Calédonie (Balansac), à Djibouti (H. Coutière), à Murray Island (Haddon).

32. *A. Seurati* n. sp. (Pl. LXXV. fig. 20).

La forme du bord frontal rappelle de très près l'espèce précédente, les épines orbitaires et le rostre étant seulement un peu moins longs. Le stylocérite est arrondi à son extrémité, plus court que l'article antennulaire basal. L'article antennulaire médian est seulement un peu plus long que chacun des deux autres. Chez l'*A. collumianus*, au contraire, le stylocérite est terminé en pointe aigüe, et l'article antennulaire médian est 2 fois plus long que chacun des deux autres (fig. 20, 20′).

La grande pince de la 1re paire est assez semblable à celle de l'*A. collumianus*, mais la forme générale de la paume est plus ovale, le doigt fixe étant tronqué et le doigt mobile portant à faux presque en entier. De plus, le bord inférieur est crénelé, et l'épine du condyle externe moins visible que chez l'*A. collumianus* (fig. 20 *a*, *a*′).

La petite pince diffère de celle de l'*A. collumianus* de même sexe (♂) en ce que les doigts sont plus courts que la paume au lieu d'être égaux à celle-ci. En outre, la paume, chez l'*A. collumianus*, porte, très atténuées, les mêmes sculptures que sur la grande pince, en particulier les 2 sillons longitudinal et transverse, et les 2 fortes épines protégeant les condyles de l'articulation du doigt mobile. Chez l'*A. Seurati* l'épine supéro-interne est seule présente, et la surface palmaire est lisse. Le doigt mobile, comme chez l'*A. collumianus*, est bordé d'une crête tranchante.

Sur la 2^{me} paire, le segment proximal du carpe est seulement le $\frac{3}{4}$ du second, alors qu'il est un peu plus long chez l'*A. collumianus* (fig. 20 *b*).

La 3^{me} paire ne porte aucune épine sur le méropodite. Le bord inférieur, terminé par une forte dent épineuse et portant 4 épines mobiles chez l'*A. collumianus*, est seulement coupé à angle droit à son extrémité chez l'*A. Seurati* (fig. 20 *c*).

Le carpe est également inerme, le propodite porte 5 paires de fortes épines, le dactylopodite porte une griffe surnuméraire ventrale. Chez l'*A. collumianus*, où le dactyle est également bifide, le propodite porte 6 paires d'épines et le carpe, épineux à son bord inférieur distal, porte en outre une épine mobile. Le membre tout entier est plus court et plus trapu chez l'*A. Seurati*; le rapport de sa longueur totale à la largeur du méropodite est $\frac{1}{6}$, au lieu de $\frac{1}{10}$ chez l'*A. collumianus*.

Le telson et les uropodes ont sensiblement la même forme dans les 2 espèces, la rame interne porte 4—5 fortes épines (fig. 20 *d*, *e*).

Minikoi, 1 ex. ♂. Le type de l'espèce (♂) a été recueilli à l'île Marutea (archipel Gambier), par M. G. Seurat (Coll. du Muséum).

33. *A. sp.* (Pl. LXXIV. fig. 19).

Je place l'espèce ci-dessous dans le groupe "megacheles"—bien qu'aucun des spécimens ne possède ses pinces de la 1re paire—à cause de la forme du bord frontal. Celui-ci est tridenté comme chez *Synalpheus*. Le rostre est plus long que les épines latérales, et dépasse légèrement l'article basal antennulaire. Il se prolonge en arrière au delà des voûtes orbitaires, sous forme d'une carène bien marquée.

La 2me paire est très courte, le carpe est de proportions uniques dans le genre *Alpheus*: les 4 premiers segments sont de longueur régulièrement décroissante, le 4me est plus large que long, le 1er 1 fois ½ seulement aussi long que large, le 5me à peu près 2 fois (fig. 19 *a*).

Le dactyle de la 3me et 4me paire est simple, le méropodite inerme.

Le telson et les uropodes ne présentent rien de spécial. Les pattes thoraciques portent des épipodites comme chez *Alpheus*. Je pense qu'il s'agit d'une forme appartenant à ce genre, mais l'examen des pattes de la 1re paire permettrait seul de l'affirmer.

Hulule Male Atoll, 3 sp. très jeunes, sans leurs pinces. (Le céphalothorax du plus grand a 2 mm. de longueur.)

Groupe "macrochirus" (H. Coutière, *loc. cit.* p. 351).

34. *A. macrochirus* Richters.

A. macrochirus Richters, *Meeresfauna Ins. Mauritius*, p. 164, pl. 17, 1880.

Hulule Male Atoll, 8 sp. ♂ et ♀.

L'espèce se trouve également à l'île Maurice (Richters), Tahiti (d'ap. Ortmann, Mus. de Strasbourg), à Madagascar (G. Grandidier), à Fernando-Veloso (Heurtel), au Congo (Pobéguin), dans le golfe de Californie (Diguet).

35. *A. ventrosus* H. M.-Edwards.

A. ventrosus H. M.-Edwards, *H. Nat. Crust.*, t. 2, p. 352, 1837.

A. laevis Randall, *J. Acad. Sc. Philadel.*, vol. VIII. 1839.

L'examen des types de H. M.-Edwards ne permet aucun doute sur l'identité de l'*A. ventrosus* et de l'espèce si souvent décrite sous le nom de *A. laevis*, depuis le description très incomplète de Randall.

Hulule Male Atoll, Naifaro Reef, Fadifolu Atoll, South Nilandu Atoll, Suvadiva Atoll, Horsburgh Atoll. 45 sp. ♂ et ♀.

Cette espèce est peut-être la plus largement distribuée et la plus commune de toutes celles du genre *Alpheus*. On l'a recueillie à "l'île de France" (types de H. M.-Edwards), Zanzibar, Maurice, Madagascar, les Seychelles, la mer Rouge, depuis le golfe d'Akaba jusqu'à Aden, y compris Obock, Perim, Djibouti; dans le golfe Persique, le golfe de Bengale, l'Archipel Malais, les Philippines, le détroit de Torrès, l'Australie, les archipels Fiji et Tonga, à Tahiti, en Nlle Calédonie, aux îles Sandwich (Randall, type de *A. laevis*). L'*A. ventrosus* se trouve également dans le golfe de Californie (M. Diguet).

36. *A. gracilis* var. *Alluaudi* n.

Je range sous ce nom deux spécimens privés de leurs pinces, qui se laissent distinguer de l'*A. gracilis* Heller par un unique caractère; le dactylopodite des paires 3, 4, 5 est simple, alors que chez l'*A. gracilis*, il porte une griffe surnuméraire ventrale. Par tous les autres points, ces spécimens me paraissent impossibles à distinguer de l'*A. gracilis*.

Hulule Male Atoll 2 sp. ♂.

Le type a été recueilli à Mahé (M. Alluaud); c'est un sp. ♂ également privé de ses 2 pinces de la 1re paire.

37. *A. paragracilis* H. Coutière (Pl. LXXVI. fig. 22).

A. paragracilis H. Coutière, *Bull. Mus.* No. 7, p. 303, 1898.

Minikoi (1 sp. provenant de trous de *Teredo* (?) dans une pièce de bois), Hulule Male Atoll, Goidu Atoll, 17 sp. ♂ et ♀.

J'ai cru devoir figurer cette belle espèce (fig. 22—22 *g*), dont je n'avais donné antérieurement qu'une description assez brève et une figure se rapportant à la grande pince. Elle est voisine de l'*A. rostratipes* Pocock, mais dans cette dernière espèce, le rostre est beaucoup plus court, les articles antennulaires aussi larges que longs; le scaphocérite n'est pas plus long que le pédoncule antennulaire.

La petite pince, seule présente sur le type de Pocock, est plus grande que chez l'*A. paragracilis*, les doigts sont plus longs que la paume et leurs pointes croisées; la 2me paire est très courte, les segments 2, 3, 4 du carpe sont presque aussi larges que longs. Les méropodites des pattes 3 et 4 sont inermes, le dactyle bifide, les 2 griffes étant presque égales.

L'*A. rostratipes* Pocock est de Fernando-Noronha. L'*A. paragracilis*, indépendamment des Maldives et Laquedives, a été recueilli à Tahiti (Abbé Cullieret), Nossi-bé (G. Grandidier), Djibouti (H. Coutière).

38. *A. idiocheles* n. sp. (Pl. LXXV. fig. 21).

Cette remarquable espèce est difficile à classer dans l'un ou l'autre des groupes de formes pratiqués dans le genre *Alpheus*.

Les voûtes orbitaires sont très saillantes, hémisphériques et inermes; entre elles s'étend le rostre court et large, prolongé en arrière par une crête assez saillante un peu au delà des voûtes orbitaires, les dépassant en avant, il atteint le tiers distal de l'article antennulaire basal. Le stylocérite n'atteint que le milieu du même article; il est arrondi et mousse. L'article antennulaire médian est près de 2 fois aussi long que chacun des deux autres (l'article basal étant mesuré seulement à partir du bord frontal).

Le basicérite est tout à fait inerme. Le scaphocérite atteint à peine le tiers distal de l'article antennulaire médian, il porte une écaille à peu près nulle, faisant une légère saillie un peu en avant de l'article antennulaire basal. Le carpocérite atteint les 3/4 de la longueur de l'article antennulaire médian (fig. 21, 21′, 21″).

La 2me paire de pattes est très longue, mesurant 2 fois $\frac{1}{2}$ au moins la longueur du céphalothorax, les 2 premiers segments du carpe sont sensiblement égaux, les trois autres de longueur croissante (fig. 21).

Par tous ces caractères, l'*A. idiocheles* se rapproche beaucoup des espèces telles que l'*A. obeso-manus* Dana, mais d'autres détails de forme sont de nature à la faire placer dans le groupe "macrochirus."

La grande pince de la 1re paire, seule présente sur le type, rappelle tout à fait celle de l'*A. villosus* Olivier, que l'on aurait étirée de façon à ce que sa longueur égalât 3 fois $\frac{1}{2}$ sa hauteur. Comme chez l'*A. villosus*, le bord palmaire supérieur est dévié, et sa place occupée par une arête interrompue, ou plutôt déprimée en un point par le "sillon alphéopsidien"

transversal. Toute la région antérieure est rugueuse comme chez l'*A. rugimanus*, l'*A. malleator*, et le doigt mobile complètement en "porte à faux" (fig. 21 *a*, *a'*).

Les pattes 3 et 4 sont très robustes. Le méropodite est seulement 3 fois aussi long que large, inerme à son angle inférieur distal; le carpe est un peu plus long que le propodite sur la 3me paire, celui-ci porte 5 épines mobiles et se termine par un dactyle simple (fig. 21). Ces caractères se rencontrent aussi bien dans le groupe "macrochirus" que dans le groupe "crinitus."

La 5me paire est très faible, comparée aux deux précédentes et orientée comme celle des Thalassinidés, des Porcellanes et des Dromies. Cette disposition est la règle chez toutes les espèces domicoles d'Alphées, mais elle est particulièrement nette sur le type d'*A. idiocheles*, qui est un ♂, dont l'abdomen est très réduit, à peine plus long que le céphalothorax, et qui rappelle par ses proportions une larve Mégalope de Crabe.

Le telson est asymétrique sur le type, peut-être par suite de son adaptation à un abri de forme irrégulière. Il est presque inerme, ses épines supérieures et postérieures sont toutes très petites, et ses angles postérieurs arrondis. Le sympodite des uropodes est inerme également, la rame interne est inerme, et la rame externe porte deux épines suturales de couleur brune. Cette couleur est à peu près constante chez toutes les espèces du groupe "macrochirus" (fig. 21 *b*, *c*).

Minikoi, 1 sp. ♂.

Groupe "crinitus," H. Coutière, *loc. cit.* p. 351.

Comme je le faisais remarquer dans le travail antérieur cité, le groupe "crinitus" renferme des espèces parmi lesquelles on peut reconnaître deux directions évolutives opposées (*l. c.* p. 223—226). Des formes dont *A. crinitus* Dana est le type, et chez lesquelles la grande pince est régulièrement cylindrique, sans accidents de surface, on passe d'une part à des espèces chez lesquelles les sillons "alphéopsidiens" de la surface palmaire persistent très marqués, avec le doigt mobile de plus en plus en "porte à faux."

L'*A. obeso-manus* Dana est le type de ces formes.

D'autre part, on assiste à un allongement graduel de la grande pince, sur laquelle persiste le sillon transversal "alphéopsidien." Puis la paume s'aplatit en même temps qu'elle s'allonge, et prend les crêtes de renforcement longitudinales qui caracterisent le groupe "brevirostris."

L'*A. insignis* Heller, *A. bidens* Olivier, *A. paracrinitus* Miers sont des exemples de cette seconde catégorie d'espèces.

Tout en faisant les réserves nécessaires sur la valeur et la netteté très relatives de ces coupes pratiquées dans le genre *Alpheus*, il me semble commode d'introduire dans le groupe "crinitus" primitif deux sous-groupes: l'un qui porterait la dénomination de "obeso-manus," le second de "insignis." Le sous-groupe "crinitus" (s. stricto) serait ainsi formé par les seules espèces où tout vestige des sillons primitifs aurait disparu.

Ces trois groupes de formes sont représentés avec une abondance exceptionnelle dans la collection des Maldives et Laquedives.

Groupe "obeso-manus."

39. *A. microstylus* S. Bate (Pl. LXXVI. fig. 23).

Betœus microstylus Sp. Bate, *Macroures du Challenger*, p. 566, pl. 101, 1888, fig. 6.

Bien que le type de cette espèce, un sp. ♂ du Cap York, soit très mutilé, il me semble possible de l'identifier avec une espèce très commune à Djibouti, où je l'ai recueillie en abondance dans les galeries abandonnées de Mollusques saxicaves. C'est cette espèce que j'ai désignée et figurée sous le nom de l'*A. malleodigitus*, croyant les 2 formes synonymes, et de plus, simples variétés de l'*A. obeso-manus* Dana. Cette opinion est certainement erronée, comme je l'ai reconnu depuis longtemps et comme de Man l'a très justement fait remarquer (*Kükenthal Ergeb.* p. 866, 1902); non seulement ces trois espèces sont distinctes, mais le groupe dont elles font partie est bien plus étendu encore, comme le montrent les nouvelles formes décrites plus loin.

Le dessin de Bate met en évidence, avec une exactitude suffisante, la principale caractéristique de l'*A. microstylus*: le pédoncule antennulaire, le scapho- et le carpocérite sont sensiblement de la même longueur, l'épine du scaphocérite un peu plus longue toutefois, et l'écaille atteignant jusqu'au milieu de l'article antennulaire distal. La longueur des articles de l'antennule est bien aussi celle indiquée par Bate. Le rostre, absent sur le type, est présent sur la très grande majorité des specimens que j'ai recueillis, sous forme d'une courte et faible carène ne dépassant pas le bord des voûtes orbitaires. Mais j'ai pu constater sa réduction et son absence à peu près totale sur trois spécimens; cette anomalie est assez fréquente dans ce groupe d'espèces, et il est probable que l'absence de rostre chez l'*A. malleodigitus* et l'*A. microstylus* Sp. Bate lui est attribuable, malgré le singulier hasard qui aurait obligé à prendre pour types deux spécimens anomaux (fig. 23).

La grande pince est celle que j'ai figurée et décrite p. 223 de mon travail antérieur. La petite pince, figurée à la même page, est celle du ♂, celle de la ♀ est différente, en ce que la longueur de la paume n'est guère que 1 fois $\frac{1}{2}$ celle des doigts (1·69), ce rapport devenant 2·15 chez les ♂ (fig. 23 *a*, *a'*).

La 2^{me} paire est d'ordinaire asymétrique comme la 1re, la plus grande des pattes est 2 fois $\frac{1}{2}$ aussi longue que le céphalothorax, la plus petite à peine 2 fois. Les rapports des segments du carpe restent à peu près les mêmes dans les 2 pattes, le second étant un peu plus ou un peu moins de 3 fois aussi long que le 1er suivant que l'on considère le plus grand ou le plus petit des membres (fig. 23 *b*).

La 3^{me} paire, dont le méropodite est fortement épineux, a le carpe un peu moins long que le propodite ($\frac{15}{16}$). Le carpe est aigu à son angle inférieur distal, le propodite avec 5 épines mobiles. Le dactyle est simple (fig. 23 *e*).

La 4^{me} paire a le méropodite épineux également à son apex inférieur.

Le telson, dont j'ai figuré, p. 316 de mon travail antérieur, le bord postérieur, est 2·4 fois plus large à la base, et sa longueur mesure 3·7 fois le bord postérieur (fig. 22 *f*, *g*).

Hulule Male Atoll, 1 sp. ♂.

L'espèce se trouve aussi à Djibouti (Dr. Jousseaume, H. Coutière, Gravier) et à Mascate (Maindron).

40. *A. Lutini* n. sp. (Pl. LXXVI. fig. 24).

Cette espèce est très voisine de la précédente, dont elle diffère principalement par la réduction de l'écaille antennaire.

Le rostre fait une très courte saillie triangulaire en avant des voûtes orbitaires, et se prolonge en arrière par une crête bien nette. Entre le rostre et les voûtes orbitaires, le bord frontal fait une très légère saillie convexe.

Le stylocérite égale la moitié ou au plus les $\frac{3}{4}$ de l'article antennulaire basal. L'article médian est seulement 1 fois $\frac{1}{2}$ aussi long que chacun des deux autres.

Le carpocérite est très légèrement plus petit que le pédoncule antennulaire. Le scaphocérite, égal à ce dernier, porte une écaille tout à fait nulle, indiquée seulement par une sinuosité de l'épine, ne portant aucune soie, et ne présentant aucune partie molle et foliacée (fig. 24).

La grande pince de la 1re paire est tout à fait semblable à celle de l'*A. microstylus*. La petite pince, semblable dans les deux sexes, est 2 fois $\frac{1}{2}$ aussi longue que les doigts, 5 fois plus que le carpe, 1·75 fois plus que le méropodite (fig. 24 *a*, *b*).

La 2me paire est 3 fois aussi longue que le céphalothorax, le 1er segment très court, le second plus de 3 fois $\frac{1}{2}$ aussi long. Ces proportions sont celles de la patte la plus longue, son opposée pouvant n'avoir que 2 fois $\frac{1}{2}$ la longueur du céphalothorax, et le segment 2 du carpe n'être qu'un peu plus de 3 fois aussi long que le 1er (fig. 24 *c*).

La 3me et la 4me paire de pattes ont un méropodite robuste, fortement épineux à l'apex inférieur. Le carpe, épineux également à l'extrémité de son bord inférieur, est très sensiblement égal au propodite, qui porte 4 paires d'épines mobiles (fig. 24 *d*).

Le telson est presque 3 fois $\frac{1}{2}$ aussi large à sa base qu'à son bord postérieur, et sa longueur est plus de 6 fois celle de ce dernier, qui porte, outre les 2 paires d'épines habituelles, dont la paire interne longue et grêle, seulement 3 soies plumeuses (fig. 24 *e*).

Hulule Male Atoll, 4 sp. ♂ et ♀.

L'espèce se rencontre aussi à Samoa, et à l'île Tague (Commt du "Lutin").

41. *A. phrygianus* n. sp. (Pl. LXXVII. fig. 25).

Peut-être cette espèce correspond-elle à celle décrite par Ortmann sous le nom de l'*A. obeso-manus* var. *Japonicus*. Mais elle est sûrement distincte de l'*A. obeso-manus* Dana, et si elle se trouvait identique à l'espèce d'Ortmann, le nom de l'*A. japonicus*, donné à une espèce du groupe "Edwardsi," ne pourrait lui être conservé.

Le rostre est une pointe bien marquée, étroite, se poursuivant en arrière par une courte crête, se continuant par ses bords avec ceux des voûtes orbitaires.

Le stylocérite des antennules est arrondi, sans pointe distale, à peine égal à la moitié de l'article distal. L'article médian, très allongé, est trois fois aussi long que la portion visible de l'article basal, deux fois aussi long que l'article distal.

Le carpocérite atteint l'extrémité de l'article antennulaire médian.

Le scaphocérite porte une écaille très réduite, dépourvue de soies, atteignant à peine le tiers proximal de l'article médian, alors que l'épine du scaphocérite atteint jusqu'à la moitié du même article (fig. 25).

Chez l'*A. obeso-manus*, d'après la description et le dessin de Dana, le scapho- et le carpocérite sont égaux; ce dernier est seulement un peu plus long dans la variété *Japonicus* Ortmann.

La grande pince de la 1re paire a la forme habituelle dans ce groupe d'espèces, la plaque adhésive palmaire fait en avant une saillie très visible de profil. Le doigt mobile a sa saillie postérieure très marquée, au moins aussi longue que l'antérieure. Souvent même,

cette dernière n'est pas distincte, et le doigt mobile affecte la forme d'un bonnet phrygien (fig. 25 *a*, *a'*).

La petite pince, semblable dans les deux sexes, est étroite, les doigts une peu plus courts que la paume (rapport de la paume aux doigts 1·07). Le carpe a $\frac{1}{5}$ de la longueur de la pince, le méropodite, égal à cette dernière, est également grêle et inerme (fig. 25 *b*).

La forme de la petite pince paraît être la même dans la var. *Japonicus* Ortmann, mais les doigts sont beaucoup plus courts chez l'*A. obeso-manus* Dana (rapport de la paume aux doigts: 3).

Le membre le plus petit de la 2^{me} paire est égal à 2·2 ou 2·4 fois le céphalothorax, les segments 1 et 2 sont dans le rapport de 0·78 à 0·88. Le membre le plus grand peut atteindre 3 fois, et même 4 fois la longueur du céphalothorax, dans l'un et l'autre sexe; le rapport des 2 premiers segments du carpe croît de 0·61 à 0·73, à mesure que croît le membre lui-même (fig. 25 *c*). Ce rapport est 0·9 dans la variété *Japonicus*, et 0·3 chez l'*A. obeso-manus*.

La 3^{e} et la 4^{e} paire sont assez faiblement épineuses à l'apex inférieur du méropodite. Sur la 3^{e} paire, le carpe est plus long que le propodite (rapport 1·25), il est faiblement épineux à son apex inférieur. Le propodite porte 5 épines mobiles (fig. 25 *d*).

Le telson est près de 3 fois aussi large à sa base qu'à son bord postérieur, et sa longueur égale 4 fois $\frac{1}{2}$ ce dernier. Il est par conséquent très atténué à son extrémité, qui porte 2 paires d'épines, dont les internes très longues et grêles, et 10 soies plumeuses (fig. 25 *e*).

Hulule Male Atoll, Suvadiva Atoll, 4 sp. ♂ et ♀. L'espèce se rencontre aussi à Madagascar (G. Grandidier), à l'île Tague (Comm^{t} du "Lutin").

42. *A. Danæ* n. sp. (Pl. LXXVII. fig. 26).

Cette espèce est encore très voisine de l'*A. obeso-manus* Dana, qui ne se rencontre pas dans les collections des Maldives et Laquedives.

Sur l'unique spécimen que j'ai examiné, le rostre ne fait aucune saillie en avant, et n'est indiqué que par une crête, bien distincte entre les voûtes orbitaires. Il est probable qu'il s'agit de l'anomalie dont j'ai déjà parlé à propos des types de Sp. Bate.

Le stylocérite est égal à la moitié de l'article antennulaire basal, arrondi et non épineux à son extrémité. L'article médian est un peu plus de 2 fois aussi long que l'article distal, et 2 fois $\frac{1}{2}$ aussi long que la portion visible de l'article proximal.

Le carpocérite et le scaphocérite atteignent l'un et l'autre le milieu de l'article antennulaire médian, comme chez l'*A. obeso-manus* Dana, et l'écaille du scaphocérite, munie de soies sur son bord externe, atteint le quart proximal de l'article antennulaire médian (fig. 26).

La grande pince manque. La petite pince a les doigts plus courts que la paume, mais, comparés à la longueur totale de la pince, ils sont avec celle-ci dans le rapport de 2·75. Ce rapport devient égal à 4 chez l'*A. obeso-manus* Dana, dont les doigts de la petite pince sont extrêmement courts. Le type de l'*A. Danæ* est, il est vrai, une ♀, et il pourrait s'agir d'une différence sexuelle, si le type de l'*A. obeso-manus* se trouvait être un ♂.

La petite pince est plus longue que le méropodite (rapport 1·37) et près de 3 fois $\frac{1}{2}$ aussi longue que le carpe (fig. 26 *a*).

Les pattes de la 2me paire sont extrêmement longues, inégales, la plus grande a plus de 3 fois ½ la longueur du céphalothorax, son opposée 2 fois ½ seulement. Les segments du carpe 2 et 1 sont comme 1·5 sur la plus longue, comme 1·33 sur la plus courte, alors qu'ils sont comme 3·33 chez l'*A. obeso-manus* Dana (fig. 26 *b*).

Les pattes 3 et 4 sont assez faiblement épineuses à l'apex inférieur du méropodite ; sur le 3e paire le carpe, aigu à son apex inférieur, est plus long que le propodite (rapport 1·32), celui-ci est plus grêle que le carpe, et porte 5 spinules mobiles (fig. 26 *c*).

Le telson est 2 fois ½ aussi large à sa base qu'à son bord postérieur, et un peu moins de 4 fois aussi long que ce bord. La paire d'épines interne de celui-ci est seulement un peu plus longue que la paire externe, et l'on compte 10 soies entre ces 2 paires d'épines (fig. 26 *d*).

Hulule Male Atoll, 1 sp. ♀.

Groupe "crinitus" (sensu stricto).

43. *A. ovaliceps* n. sp. (Pl. LXXVII. fig. 27).

Le rostre est égal à la moitié de l'article basal antennulaire, et se prolonge sous forme d'une courte et forte carène entre les orbites, dont il est séparé par une dépression bien marquée. Le bord des voûtes orbitaires est arrondi et inerme. Le stylocérite est plus court que l'article antennulaire basal, celui-ci de même longueur que le médian, l'article distal un peu plus court.

Le basicérite porte à son angle inférieur une forte épine aussi longue que l'article antennulaire basal. Le carpocérite est volumineux, cylindrique, depassant le pédoncule antennulaire des ¾ de l'article distal. L'épine du scaphocérite atteint aussi loin en avant que le carpocérite, l'écaille antennaire, assez étroite, s'étend jusqu'à la moitié de l'article antennulaire distal (fig. 27).

L'article distal des maxillipèdes est plus de 2 fois aussi long que le pénultième article. Celui-ci porte, outre quelques soies sur ses bords, deux longs poils tubuleux en forme de massue à l'extrémité, aussi longs que l'article lui-même (fig. 27 *a*).

La grande pince de la 1re paire est de forme ovoïde, un peu atténuée à l'extrémité distale ; sa surface est lisse sauf une très légère dépression transversale, immédiatement derrière la "plaque adhésive" palmaire, qui est ainsi rendue plus saillante, surtout de profil. Le doigt mobile est obtus, court et massif, à peine incurvé au bord inférieur, et son extrémité s'oppose sensiblement à la pointe du doigt mobile : le rapport de la longueur totale de la pince à celle des doigts est 3·2, celui de la longueur à la hauteur 2·4. Le carpe et le méropodite sont trapus et lisses, le dernier à peine 1 fois ½ aussi long que large, inerme (fig. 27 *b*, *b'*).

La petite pince est également de forme ovoïde et lisse, les doigts sont courts, coniques, les rapports précédents, indiqués pour la grande pince, sont sur la petite, respectivement, 2·5 et 3 (fig. 27 *c*).

Sur la 2me paire, le 1er segment du carpe est légèrement plus long que le second, le 3me étant le plus court de tous. Le rapport de la longueur de la 2me paire, à celle du céphalothorax, est 1·8 (fig. 27 *d*).

Le méropodite de la 3me paire est ovale, inerme à son apex inférieur, 3 fois aussi long que large. Le propodite est plus long que le carpe (rapport 1·2) et porte 5 paires d'épines

mobiles; le dactyle est simple, régulièrement courbé; l'ischiopodite des pattes 3 et 4 porte une épine enfoncée, mobile (fig. 27 *e*).

Le telson est régulier, avec les épines supérieures et postérieures fortes et bien marquées. Le bord postérieur, régulièrement arrondi, porte 20 soies. L'épine suturale de l'uropode externe est de couleur brun foncé, comme dans la plupart des espèces du groupe "macrochirus," auxquelles l'espèce est encore rattachée par l'absence d'armature épineuse sur le méropodite des pattes 3 et 4.

L'*A. ovaliceps* est voisin de l'*A. architectus* de Man, mais, dans cette dernière espèce les bords orbitaires sont épineux, la crête dorsale plus prolongée en arrière, l'article antennulaire médian 1 fois $\frac{1}{2}$ plus long que le basal; l'épine latérale du scaphocérite est seulement égale au pédoncule antennulaire, et l'écaille atteint à peine la moitié de l'article médian. En outre l'*A. architectus*, par sa grande pince, se rapproche de l'*A. malleodigitus*; le dactyle des pattes 3 et 4 est bifide, le telson épineux sur la ligne médiane. Enfin, le 1er segment du carpe, sur la 2^{me} paire, est beaucoup plus long que le second.

L'*A. ovaliceps* est beaucoup plus voisin de l'*A. Ascencionis* Ortmann, mais dans cette dernière espèce le basicérite est à peu près inerme, le méropodite de la grande pince est légèrement épineux à son angle supéro-interne distal; enfin, la petite pince a les doigts linéaires, faibles, et plus longs que la paume.

Minikoi, 1 sp. ♂.

44. *A. styliceps* n. sp. (Pl. LXXVIII. fig. 28).

Le rostre est très proéminent en avant des voûtes orbitaires, auxquelles ses côtés se raccordent par deux plages à bord convexe. La carène rostrale ne dépasse guère en arrière les voûtes orbitaires très saillantes. Le rostre atteint le tiers distal de l'article antennulaire basal (portion visible), l'article médian est un peu plus long et plus étroit, l'article distal égal aux $\frac{2}{3}$ du précédent. Le stylocérite, aigu, est aussi long que l'article distal.

Le basicérite est inerme. L'épine du scaphocérite égale le pédoncule antennulaire, l'écaille, peu développée, atteint la moitié de l'article antennulaire médian. Le carpocérite dépasse le pédoncule des antennules de presque toute la longueur de l'article distal (fig. 28).

L'article distal des maxillipèdes est allongé, deux fois au moins aussi long que le pénultième.

La grande pince de la 1re paire est régulièrement cylindrique, entière et lisse, sauf un très léger sillon derrière la plaque adhésive palmaire. Le doigt fixe se termine en pointe obtuse; le doigt mobile est convexe dorsalement, de forme très obtuse à sa pointe, et en "porte à faux" sur le tiers distal de sa longueur. Le rapport de la longueur de la pince totale à celle du doigt mobile est 3·65, celui de la longueur à la hauteur, 2·21 (fig. 28 *a*).

La petite pince a les doigts longs, cylindriques, styliformes, plus de 1 fois $\frac{1}{2}$ aussi longs que la paume qui est très renflée, ovoïde, et plus haute que les doigts fermés (fig. 28 *b*, *b'*).

Le méropodite des 2 pinces paraît épineux vu latéralement, par suite d'un lobe procédent, développé seulement du côté interne de l'article, près de son extrémité supérieure distale (fig. 28 *a'*).

La 2^{me} paire est courte et robuste, le 2^{me} segment du carpe est plus long que le 1er, les segments 3, 4, 5 de longueur croissante, et leur somme égale au segment 2 (fig. 28 *c*).

Le méropodite de la 3me paire est fortement épineux à son apex inférieur distal, 3 fois aussi long que large. Le carpe est court ($\frac{1}{3}$ du méropodite), arrondi à son apex inférieur distal ; le propodite est plus long que le carpe (rapport 1·7) avec 6 épines mobiles. Le dactyle est simple, robuste et court (fig. 28 *d*).

Le méropodite de la 4me paire est épineux (d'un côté seulement sur le type). Les ischiopodites des pattes 3 et 4 ne portent pas d'épine enfoncée mobile.

Le telson est de forme régulière, sans épines sur la ligne médiane, arrondi à son bord postérieur, qui a comme largeur un peu plus du tiers du bord antérieur, et $\frac{1}{5}$ de la longueur totale. La rame interne des uropodes porte 5 épines sur son bord, l'épine suturale de la rame externe a l'aspect hyalin habituel.

Cette belle espèce est très voisine de l'*A. architectus* de Man par les proportions de ses deux paires d'antennes, mais elle a les bords orbitaires inermes. Elle s'en distingue aussi facilement par la forme de la grande pince, plus massive, et entière à son extrémité distale, plus encore par la forme de la petite pince, très caractéristique de l'*A. styliceps* ; enfin, par les méropodites 3 et 4 épineux, et l'absence d'épines sur le bord postérieur et la ligne médiane du telson, caractère dont l'*A. architectus* offre jusqu'à présent le seul exemple connu chez les Alpheidae.

La forme de la petite pince distingue l'*A. styliceps* de toutes les espèces du groupe "crinitus" (s. stricto) où les méropodites sont épineux. Par contre, elle la rapproche beaucoup de l'*A. Ascensionis* Ortmann[1]. Dans cette espèce toutefois, le rostre et le bord frontal paraissent un peu différents, le 2me article des antennules n'est pas plus long que l'article basal. La grande et la petite pince paraissent semblables, autant que permet d'en juger la brève diagnose d'Ortmann, non accompagnée de figures. La 2me paire est différente, le 2me segment du carpe étant plus petit que le 1er. Enfin, la 3me et la 4me paire ont leurs méropodites inermes.

L'*A. styliceps* est représenté par un unique sp. ♂, provenant de Naifaro Reef.

45. *A. bucephalus* n. sp. (Pl. LXXVIII. fig. 29).

A. crinitus Dana, H. Coutière, *loc. cit.* p. 226, fig. 273.

Cette espèce est l'une de celles qui ressemblent le plus à la description et à la figure de Dana, mais je ne pense pas que les deux soient synonymes, comme je l'avais d'abord écrit, avant d'avoir étudié de façon rigoureuse les formes si nombreuses qui s'en rapprochent.

Le rostre, assez aigu, et bien marqué, se prolonge en arrière un peu au delà des voûtes orbitaires. Les sillons rostro-orbitaires sont bien nets, limités en arrière de façon à rappeler l'*A. armillatus* (H. Coutière, *loc. cit.* fig. 66, 67, p. 97), avec cette différence que les bords des sillons sont très estompés et mousses au lieu d'être tranchants et à pic. Les voûtes orbitaires, hémisphériques, se raccordent à la pointe rostrale par un bord en S, dessinant une large saillie arrondie en avant de chaque orbite (fig. 29).

L'article antennulaire médian est seulement un peu plus long que chacun des deux autres, le stylocérite est plus court que l'article basal, aigu à son extrémité.

Le basicérite est inerme, le scaphocérite un peu plus grand que le pédoncule antennulaire ; l'écaille, large, est presque aussi longue que ce pédoncule, que le carpocérite dépasse des $\frac{3}{4}$ de l'article distal, étant de la sorte un peu plus long que l'épine du scaphocérite.

[1] Ortmann, *Dek. der Plankt. Exped.* p. 45, 1893.

La grande pince de la 1re paire a la forme commune à toutes les espèces du groupe, la paume est cylindro-ovoïde, entière et lisse, sauf une très légère dépression, surtout marquée du côté inféro-interne, et située derrière la "plaque adhésive" palmaire. Celle-ci est grande, et très apparente aussi bien que son opposée du doigt mobile; ce doigt est court, semi-circulaire, sa pointe obtuse s'oppose sensiblement à celle du doigt fixe. Le rapport de la pince entière à celle des doigts est 3; vis à vis de la hauteur, mesurée dans le plan des doigts, un peu supérieur à 2 (fig. 29 *a*).

Le méropodite est inerme, 1 fois $\frac{1}{2}$ environ aussi long que large (fig. 29 *a'*); l'ischiopodite présente en avant une volumineuse saillie anguleuse. La forme de la pince est la même chez la ♀, et les dimensions seulement un peu inférieures.

La petite pince est également de forme identique dans les deux sexes, un peu plus robuste chez le ♂; les doigts sont coniques, égaux aux $\frac{7}{8}$ de la paume chez le ♂, un peu plus courts chez la ♀ ($\frac{6}{7}$), garnis de longues soies sur leur face externe, de même que la paume. Le méropodite et l'ischiopodite comme sur la grande pince (fig. 29 *b*, *b'*).

Le 2me segment du carpe de la 2me paire est plus de 2 fois aussi long que le 1er, le 5me plus long que le 1er (fig. 29 *c*).

La 3me et la 4me paire sont courtes et trapues, le méropodite est fortement épineux à l'apex inférieur distal, ses bords sont nus et étroits (fig. 29 *d*, *d'*).

Le carpe est égal au propodite, inerme sauf une pointe aigüe à son apex inférieur. Le propodite a 6 paires d'épines mobiles, et, comme le carpe, de longues soies sur son bord antérieur. Le dactyle est robuste, simple, régulièrement courbé. Les ischiopodites 3 et 4 portent une forte épine mobile.

Le telson s'atténue un peu avant le bord postérieur, qui a les $\frac{3}{4}$ du bord antérieur et les $\frac{4}{5}$ de la longueur, les épines supérieures et postérieures sont très fortes, entre ces dernières on compte 20 soies plumeuses (fig. 29 *e*).

L'épine suturale de la rame externe des uropodes est longue et forte, la rame interne porte 7—8 épines sur son bord externe (fig. 29 *f*).

D'après la diagnose et le dessin de Dana[1], *A. crinitus* aurait le scaphocérite plus petit que le pédoncule antennulaire, et, des 2 premiers segments du carpe de la 2me paire, le second serait seulement un peu plus grand que le 1er. La 2me paire serait d'ailleurs plus longue que chez l'*A. bucephalus*, où elle ne dépasse guère la 1re paire en longueur. La 3me paire est plus longue et plus grêle chez l'*A. crinitus*. Enfin, les doigts de la grande pince ont seulement $\frac{1}{4}$ de la paume, au lieu de $\frac{1}{3}$ chez l'*A. bucephalus*. La description de Dana ne donne d'ailleurs aucun renseignement sur la forme de l'écaille antennaire et des méropodites de la 1re paire, ce qui s'oppose à sa comparaison plus rigoureuse avec l'*A. bucephalus* et les espèces suivantes.

Hulule Male Atoll, Minikoi, 7 ex. ♂ et ♀ : l'espèce se rencontre également au Cap (de Castelnau), à Fernando-Veloso (Heurtel), à Mahé (Alluaud), à Djibouti (Dr. Jousseaume, H. Coutière).

46. *A. bradypus* n. sp. (Pl. LXXVIII., Pl. LXXIX. fig. 30).

Le rostre naît entre les yeux comme une courte pointe triangulaire, ne dépassant guère le bord frontal, s'etendant en arrière un peu au delà des voûtes orbitaires. Les sillons rostro-orbitaires sont beaucoup moins marqués que chez l'*A. bucephalus*.

[1] Dana, *U.S. Expl. Exped.* pl. 34, fig. 8, 1852.

L'article antennulaire médian égale 1 fois ½ l'article basal (portion visible), 2 fois l'article distal. Le stylocérite est aigu, et plus court que l'article basal. Le basicérite est inerme, le scaphocérite un peu plus long que le pédoncule antennulaire et le carpocérite, lesquels sont égaux. L'écaille du scaphocérite est très réduite, elle porte des soies sur son bord libre, qui atteint le tiers distal de l'article antennulaire médian (fig. 30).

Les grandes pinces de la 1re paire sont absentes sur les types ♂ et ♀. La petite pince est nettement différente dans les deux sexes, la pince totale est environ 2 fois ½ aussi longue que les doigts, le rapport de sa longueur à sa hauteur est 2·7 chez le ♂, 3·4 chez la ♀. De plus, le doigt mobile du ♂ est beaucoup plus large, et porte du côté interne une brosse de soies très serrées qui manque chez la ♀ (fig. 30 *a*, *a'*).

Le méropodite est extrêmement robuste, de forme losangique, 1 fois ½ à peine aussi long que large, inerme, de forme semblable dans les 2 sexes. Les ischiopodites ne font pas de saillie antérieure.

Sur la 2me paire, à peu près égale en longueur au plus petit des membres de la 1re paire, le 2me segment du carpe est plus grand que le 1er, surtout chez le ♂ (rapports 1·75 chez le ♂, et 1·4 chez la ♀) (fig. 30 *b*, *b'*).

La 3me paire a le méropodite extrêmement large et robuste, le rapport entre sa longueur et sa hauteur est 2·75, l'apex inférieur distal se termine en une large et forte saillie épineuse. L'ischiopodite, par contre, est inerme.

Le carpe et le propodite sont beaucoup plus étroits que le méropodite, le carpe inerme, sauf son apex inférieur terminé en pointe aigüe, égal au propodite, qui porte 4 paires de fortes épines. Le dactyle est robuste, simple et régulièrement courbé (fig. 30 *c*).

Le telson est de forme normale, son bord postérieur a ⅓ de sa longueur, un peu plus de la moitié du bord antérieur ; la paire interne d'épines postérieures est 2 fois ½ aussi longue que la paire externe. La rame interne des uropodes ne porte pas d'épines sur son bord libre (fig. 30 *d*, *e*).

La largeur du méropodite, sur les paires 1, 3 et 4, différencie très nettement cette espèce de l'*A. crinitus* Dana, de même que la forme arrondie et inerme des voûtes orbitaires la distingue de l'*A. brevipes* Stimpson.

L'*A. parabrevipes* H. Coutière[1], en diffère jusqu'à présent par la longueur différente des segments 1 et 2, sur le carpe de la 2me paire. Je n'ai pas dessiné le méropodite entier de la grande pince de la 1re paire sur le type de l'*A. parabrevipes*, dont la petite pince est absente ; cet article me paraît beaucoup moins robuste que chez l'*A. bradypus*, d'après le fragment que je trouve représenté sur mon croquis.

En outre, chez l'*A. parabrevipes*, le carpo- et le scaphocérite sont plus grands que le pédoncule antennulaire.

Minikoi, 2 sp. ♂ et ♀.

47. *A. aculeipes* n. sp. (Pl. LXXIX. fig. 31).

Le rostre, très court, ne dépasse pas le bord frontal, et se prolonge en arrière assez au delà des voûtes orbitaires. Celles-ci, très renflées, se raccordent aux bords de la pointe rostrale par une ligne en S dont l'inflexion est assez accentuée (fig. 31).

[1] H. Coutière, *Bull. Soc. Ent. Fr.* No. 6, p. 169, 1898.

Le stylocérite, court et aigu, n'atteint pas l'extrémité de l'article antennulaire basal. L'article médian est près de 2 fois aussi long que le précédent, 1 fois $\frac{1}{2}$ l'article distal. Le basicérite est inerme. Le carpocérite dépasse le pédoncule antennulaire le plus souvent des $\frac{3}{4}$ de l'article distal, parfois un peu moins. Le scaphocérite est de longueur plus variable, tantôt égal au carpocérite, tantôt au pédoncule antennulaire (fig. 31 *a*).

L'écaille antennaire dépasse en général l'extrémité de l'article médian, mais elle peut être plus petite, ou seulement égale. Les variations de sa longueur paraissent se produire en sens inverse de celles de l'épine externe, règle assez générale dans les espèces où l'écaille antennaire tend à se réduire, mais je n'ai pu définir de variété bien tranchée parmi les spécimens examinés (fig. 31 *a'*, *a''*).

La grande pince de la 1re paire est cylindro-ovoïde, entière, sans même de dépression derrière le bord palmaire antérieur, les doigts sont courts, ils n'ont guère que le quart de la longueur totale de la pince, qui est un peu plus haute que large (rapports : 2·4 et 2·66). Elle a la même forme chez la ♀, et ne diffère de celle du ♂ que par ses dimensions un peu moindres. Elle ne porte que quelques rares soies dans l'un et l'autre sexe (fig. 31).

La petite pince est peu différente dans les deux sexes. Le méropodite est de même longueur, mais plus grêle chez la ♀, ainsi que le carpe. La pince est plus courte et plus étroite chez la ♀, dans le rapport de 1 à 1·25. Les doigts, coniques, portant seulement quelques soies, paraissent un peu plus courts chez les ♀ (fig. 31 *b*, *c*).

La 2me paire n'est pas plus longue que le membre le plus petit de la 1re paire. Le 1er segment du carpe a moins du tiers du second (rapport 3·3), lequel est plus long que la somme des 3 suivants (fig. 31).

Sur la 3me paire, dont l'ischiopodite est épineux, le méropodite est 5 fois aussi long que large, un peu plus court que la somme du carpe et du propodite (de façon très générale, les 2 branches du compas basi + ischio + méropodite, carpo + pro + dactylopodite, sont égales, chez les Alpheidae, sur les péréiopodes 2, 3, 4, 5). Le méropodite se termine à son apex inférieur externe par une épine aigüe et assez grêle, et porte en outre, sur toute la longueur du bord interne, une rangée de spinules grêles, longues de 2/10 de mm. environ, au nombre d'une vingtaine, plus nombreuses et plus fortes chez les ♀ ; elles sont à peu près invisibles en regardant le membre du côté externe, les 2 bords inférieurs, interne et externe, étant très distincts sur le merus et le carpe (fig. 31 *d*, *d'*).

Le carpe, épineux à son apex inférieur externe, porte en outre une épine mobile près du même bord vers la moitié de sa longueur, plus 5—6 longues soies. Le bord interne porte une dizaine de soies, plus fortes à la base, donnant l'aspect de spinules très allongées et flexibles.

Le propodite est plus long que le carpe (rapport, 1·4), il porte 7 paires d'épines mobiles et une épine aussi à l'apex de son bord supérieur. Il est frangé de longues soies sur ses 2 bords. Le dactyle est nettement bifide, l'accessoire ventrale étant toutefois courte et obtuse, dans un plan différent de la griffe principale (fig. 31 *d''*).

La 4me paire a le méropodite et le carpe tout à fait lisses et inermes, sauf une trace de denticulation à l'apex du méropodite (fig. 31 *e*). L'ischiopodite porte aussi une épine. La 5me paire est, comme d'ordinaire dans le groupe "crinitus," très courte et faible.

Le telson est seulement un peu plus étroit à son bord postérieur (rapport, 0·75) qu'à sa base, qui a la moitié de sa longueur. La rame interne de l'uropode porte 6—7 épines (fig. 31 *f, g*).

Par la longueur et les proportions de la 2me paire, la présence de longues soies parallèles sur les 2 pinces de la 1re paire, l'*A. crinitus* Dana se distingue nettement de cette espèce comme des précédentes, sans parler même de l'armature épineuse de la 3me paire, qui aurait pu être omise dans sa description.

South Nilandu Atoll, Hulule Male Atoll, North Male Atoll, Miladumadulu Atoll, Naifaro Reef, 23 sp. ♂ et ♀.

L'espèce se rencontre aussi à Djibouti (H. Coutière), à Fernando-Veloso (Heurtel).

48. *A. paraculeipes* n. sp. (Pl. LXXIX., Pl. LXXX. fig. 32).

J'ai décrit primitivement l'espèce *A. spongiarum* H. Coutière, comme une variété de l'*A. crinitus* Dana, adaptée à la vie dans les Éponges. Non seulement l'*A. spongiarum* est bien distinct spécifiquement, mais encore ce n'est pas de l'*A. crinitus* Dana, qu'il convient de faire dériver cette espèce; elle se rattache de la façon la plus étroite à la nouvelle forme décrite ci-dessous, laquelle est elle-même très voisine de l'*A. aculeipes.*

La forme du bord frontal est très comparable. La ligne en forme d'S qui joint les voûtes orbitaires à la pointe rostrale est toutefois moins infléchie, et plus ouverte à ses 2 extrémités, chez l'*A. paraculeipes* que chez l'*A. aculeipes.*

L'article antennulaire médian est plus long dans la nouvelle espèce. Le basicérite, le carpo- et le scaphocérite sont semblables, mais la réduction de l'écaille antennaire, déjà commencée chez l'*A. aculeipes,* est ici tout à fait accomplie, la portion foliacée du scaphocérite, munie de quelques soies, n'atteignant guère que le tiers proximal de l'article antennulaire médian (fig. 32).

Les maxillipèdes externes sont plus effilés, les rapports de longueur entre l'article distal et le pénultième étant 4·8 au lieu de 3·4 chez l'*A. aculeipes* (fig. 32 *a*).

La grande pince de la 1re paire est plus renflée, le rapport de la longueur à la hauteur est 2·14 au lieu de 2·4 chez l'*A. aculeipes* (fig. 32 *b, b'*). La petite pince est de forme plus renflée, et les différences sont aussi plus grandes entre les sexes. Le rapport de la longueur à la largeur reste égal à 3 chez le ♂ et la ♀, mais le rapport de la longueur totale à celle des doigts est de 2·36 chez les ♀, de 2·24 seulement chez les ♂, où les doigts sont relativement plus courts et un peu plus larges. Les méropodites sont inégaux, en rapport avec les dimensions des pinces (fig. 32 *c, d*).

La 2me paire rappelle très étroitement celle de l'*A. aculeipes* (fig. 32 *e*).

Sur la 3me paire, dont l'ischiopodite est inerme, le méropodite est plus trapu (rapport de sa longueur à sa largeur, 3·88 au lieu de 5), il porte aussi une forte épine à l'apex de son bord inférieur externe, lequel est tout à fait glabre, au lieu de porter 4 à 5 soies comme chez l'*A. aculeipes.* Le bord interne, très distinct de l'externe, porte 25—30 spinules flexibles, incurvées à la pointe, longues de 3/10 de mm. et rappelant des soies (fig. 32 *f, f'*).

Le carpe n'est pas épineux à son apex inféro-externe, il porte une épine mobile sur ce bord, et 4—5 fines soies. Sur son bord interne, 14—15 spinules flexibles, plus longues que sur le méropodite.

Le propodite, 1 fois ½ aussi long que le carpe, porte 7 paires d'épines mobiles, légèrement incurvées en dedans, et une rangée de longues soies sur ses 2 bords, celles du bord

inférieur perpendiculaires à l'article. Il y a aussi une épine mobile à l'apex supérieur du propodite et le dactyle est bifide.

La 4me paire est entièrement inerme (fig. 32 *g*).

Le telson et les uropodes comme chez l'*A. aculeipes*.

L'*A. paraculeipes*, facile à distinguer de l'espèce précédente, est surtout voisin de l'*A. spongiarum* H. Coutière. Celui-ci n'en diffère guère que par les pattes de la 3me paire. Le méropodite est plus grêle (rapport des 2 dimensions 5), ses bords inférieurs bien moins marqués, le bord externe porte 7—8 longues soies perpendiculaires, le bord interne une vingtaine de soies très courtes et très faibles, vestige évident de l'armature présente dans les 2 espèces précédentes (fig. 33).

Le carpe n'a pas d'épines sur son bord externe, il est tout à fait inerme à son apex inférieur, et porte au bord externe 7—8 longues soies perpendiculaires, une dizaine de spinules flexibles au bord interne.

Le propodite porte 8 paires d'épines mobiles, fortement courbées vers le membre; il n'a de soies que sur son bord supérieur et ne porte pas d'épine à son apex supérieur. Enfin, le dactyle ne porte pas trace de griffe accessoire. Il est probable qu'il s'agit d'une espèce absolument liée à son habitat, créée par lui, et ne se trouvant jamais en dehors des Éponges où je l'ai recueillie à Djibouti.

South Nilandu Atoll, Mahlosmadulu Atoll, North et South Male Atoll, 9 ex. ♂ et ♀.

49. *A. paralcyone* n. sp. (Pl. LXXX., LXXXI. fig. 34).

La pointe rostrale est large, légèrement relevée d'arrière en avant, se raccordant aux voûtes orbitaires par un bord frontal en forme d'S très ouvert. Le rostre se prolonge sous forme d'une carène bien nette assez loin en arrière des voûtes orbitaires (fig. 34, 34″).

Le stylocérite aigu s'étend presque jusqu'à l'extrémité de l'article antennulaire basal. L'article médian égale 1 fois ½ l'article distal, 1 fois 75 l'article basal (portion visible).

Le basicérite porte une épine longue et aigüe; le scaphocérite dépasse le pédoncule antennulaire de la moitié au moins de l'article distal, et l'écaille, assez développée, atteint en avant jusqu'au tiers distal du même article. Le carpocérite est beaucoup plus long que le pédoncule antennulaire, qu'il dépasse de tout l'article distal de ce dernier. L'épine du scaphocérite est d'ailleurs fréquemment aussi longue que le carpocérite (fig. 34, 34′).

La grande pince de la 1re paire est cylindrique, massive, très peu atténuée en avant, avec une dépression extrêmement faible derrière le bord palmaire antérieur; le doigt mobile est semi-circulaire, les plaques adhésives grandes. Le rapport de la pince totale à la longueur des doigts est 2·85, celui de la même dimension à la hauteur, 2·15 (fig. 34 *a*).

La grande pince de la femelle est de même forme, mais de dimensions beaucoup moindres, le rapport des deux pinces est voisin de 1·5 (fig. 34 *b*).

Le méropodite porte une forte épine à son apex inféro-interne, un lobe saillant, se projetant comme une épine, à l'apex de son bord supérieur, le rapport de sa longueur à sa hauteur est 1·35 (fig. 34 *a*′).

La petite pince est assez différente dans les deux sexes. Chez le ♂, la paume est ovoïde, sauf dans le plan des doigts à sa face supérieure, où elle est très nettement aplatie et même un peu concave. Les doigts sont égaux à la paume, le doigt mobile est assez forte-

ment élargi en son milieu, de forme lancéolée. Le rapport de la longueur de la pince à la hauteur de la paume est de 3 (fig. 34 *c*).

Le méropodite est court et renflé, le rapport de sa longueur à sa hauteur est 1·5 environ. Il porte une forte dent épineuse à son apex inféro-interne.

Chez la ♀, le méropodite de la petite pince est plus étroit, le rapport précédent devient égal à 2·55. Les doigts sont aussi égaux à la paume, mais le doigt mobile est étroit, régulièrement conique, et le rapport entre la longueur et la hauteur de la pince devient 3·4. Le rapport entre la longueur des deux pinces chez le ♂ et la ♀ est de 1·36 environ (fig. 34 *d*).

La 2^{me} paire est intermédiaire comme longueur, chez le ♂, entre les 2 membres de la 1re paire. Le 2^{me} segment du carpe est beaucoup plus long que le 1er (rapport 2·43) (fig. 34 *e*).

Sur la 3^{me} paire le méropodite est cylindrique, 4 fois aussi long que large, fortement épineux à son apex inférieur distal. Son bord inférieur, très étroit, ne porte que 7 à 8 soies très fines et courtes, sans trace de spinules. L'ischiopodite porte une épine mobile enfoncée (fig. 34 *f*).

Le carpe est épineux à son apex inférieur et porte en outre 3—4 fortes épines mobiles, rarement deux seulement. Le propodite est avec le carpe dans le rapport de 1·3, il porte 8 paires d'épines mobiles, une épine également à l'apex supérieur distal. Le dactyle est très nettement bifide, la griffe surnuméraire ventrale étant à peu près aussi longue que la principale. Le carpe et le propodite portent de longues soies, au bord supérieur seulement.

Sur la 4^{me} paire, le méropodite est faiblement épineux, mais le carpe porte encore 2 épines mobiles, dans les 2 sexes. Le dactyle est également bifide et l'ischiopodite muni d'une épine.

Le bord postérieur du 6^{me} segment abdominal porte de part et d'autre de la ligne médiane 2 prolongements épineux, présents chez le ♂ et la ♀, pouvant parfois manquer ou être très peu marqués.

Le telson est peu atténué à son bord postérieur (rapport de sa base à ce bord, 1·4) (rapport de la longueur du telson à celle du bord postérieur, 2·8); ses épines supérieures et postérieures sont très robustes, entre les dernières se trouvent 15—16 soies plumeuses. L'épine suturale de la rame externe de l'uropode est longue, fortement courbée en dedans, la rame interne porte 10 épines sur son bord libre (fig. 34 *g*, *h*).

L'*A. alcyone*[1] de Man, très voisin de cette espèce, s'en distingue par l'absence d'épine au basicérite, par la 3^{me} paire dont l'ischiopodite n'est pas épineux, dont le méropodite porte quelques spinules flexibles, dont le carpe est moins fortement épineux, dont le dactyle n'est pas bifide; les proportions de la 2^{me} paire sont légèrement différentes aussi.

South Nilandu Atoll, Miladumadulu Atoll, North Male Atoll, Mahlos Atoll, 11 sp. ♂ et ♀.

50. *A. superciliaris* n. sp. (Pl. LXXXI. fig. 35).

Cette espèce est très caractéristique par la forme du bord frontal. Le rostre naît entre deux lobes semi-circulaires portant chacun 7—8 longues soies, les voûtes orbitaires ne commençant qu'en arrière de ces lobes. Prolongé en arrière un peu au delà des voûtes orbitaires—qui sont hémisphériques et très saillantes—le rostre est bien marqué, en forme de pointe aigüe atteignant le milieu de l'article basal antennulaire (fig. 35).

[1] De Man, *Kükenthal Ergeb.* p. 870, pl. 27, fig. 61, 1903.

Le stylocérite, terminé en pointe aigüe également, est un peu plus court que l'article basal. L'article médian est plus de 1 fois ½ aussi long que chacun des 2 autres.

Le basicérite porte une épine inféro-latérale assez forte. Le scaphocérite, égal au pédoncule antennulaire, porte une large écaille, atteignant en avant presque aussi loin que l'épine latérale de l'article. Le carpocérite est seulement un peu plus long que le pédoncule antennulaire.

L'article distal des maxillipèdes externes est de forme ogivale, égal à 2 fois le pénultième (fig. 35 *a*).

La grande pince est entière, cylindro-ovoïde, coupée brusquement à l'articulation du dactyle, avec de larges plaques adhésives. Le doigt mobile est de forme semi-circulaire, sa pointe s'oppose à celle du doigt fixe. Le rapport de la longueur totale de la pince à celle des doigts est 3·6, à la hauteur de la pince, 2·44. Le méropodite est inerme, 2 fois aussi long que haut (fig. 35 *b*, *b'*).

Les proportions sont les mêmes chez la ♀, dont la grande pince est seulement un peu plus petite.

La petite pince est connue seulement chez le ♂, sa longueur totale est 2 fois ½ celle des doigts. Le doigt mobile est lancéolé, notablement élargi, avec une brosse de soies courtes et serrées du côté interne. Le méropodite est presque aussi long que la pince, il est inerme, et muni, près de son apex supérieur, d'un lobe développé d'un côté seulement et se projetant de profil comme une épine (fig. 35 *c*).

La 2^{me} paire n'est pas plus longue que le membre le plus petit de la 1re paire; le 1er segment du carpe a plus de deux fois le 2^{me} (rapport 2·36) (fig. 35 *d*).

Sur la 3^{me} paire, le méropodite est cylindrique, plus de 4 fois aussi long que large, pourvu d'une très forte dent épineuse à l'apex inférieur distal, complètement lisse et inerme. Le carpe est égal en longueur à la moitié du méropodite, il est épineux aussi à son apex distal et porte en outre 3 épines mobiles. Le propodite est 1 fois ½ aussi long que le carpe, avec 8 fortes épines mobiles. Le dactyle est simple, robuste, régulièrement courbé. L'ischiopodite porte une forte épine enfoncée (fig. 35 *e*).

Sur la 4^{me} paire, le méropodite est épineux chez la ♀; l'apex inférieur distal est seulement un peu saillant, sans épine. Le carpe, pourvu de 2 épines chez la ♀, est également inerme chez le ♂ (fig. 35 *e'*).

Le telson est large à son bord postérieur (rapport de sa base à ce bord, 1·7; rapport de sa longueur au bord postérieur, 2·79). Les épines supérieures et postérieures sont assez courtes, entre ces dernières le bord porte 20 soies plumeuses. L'épine suturale de la rame externe de l'uropode est longue, et courbée vers l'intérieur; la rame interne porte 8 épines sur son bord libre (fig. 35 *f*, *g*).

L'*A. superciliaris* se distingue facilement de l'*A. paralcyone* et de l'*A. alcyone* par l'écaille antennaire plus grande, le carpocérite plus court, la forme différente du bord frontal et de la petite pince.

Reef Naifaro, 2 sp. ♂ et ♀.

51. *A. clypeatus* n. sp. (Pl. LXXXI., LXXXII. fig. 36).

La pointe rostrale est représentée par une portion triangulaire du bord frontal, concave, relevée vers le haut, dépourvue de toute crête médiane. Celle-ci commence brusquement au niveau du bord antérieur des voûtes orbitaires, hémisphériques et très saillantes. De part et d'autre de la pointe rostrale, le bord frontal, vu en dessus, se montre rectiligne, s'infléchissant

à angle droit pour se raccorder au bord des voûtes orbitaires. Vues en avant, ces deux parties du bord frontal sont fortement arquées, de façon à s'appliquer sur l'article basal antennulaire (fig. 36, 36′).

Le stylocérite est plus court que cet article, aigu à son extrémité. L'article médian est 1 fois ½ aussi long que l'article distal, près de 2 fois l'article basal (portion visible).

Le basicérite porte une forte épine inféro-latérale, le carpocérite dépasse, des ¾ de l'article distal, le pédoncule antennulaire. Le scaphocérite est égal à ce dernier, l'écaille qu'il porte est très large, et dépasse un peu, en avant, l'extrémité de l'article antennulaire médian.

Sur la 1re paire, la grande pince est cylindrique, entière et lisse (fig. 36 *a*). Le rapport de sa longueur totale à sa hauteur est 2·44, comme chez les *A. aculeipes*, *A. paralcyone*, *A. superciliaris*, le rapport de sa longueur à celle des doigts, de 3. Chez la ♀, où la grande pince est moins forte, les rapports précédents deviennent 2·6 et 3.

La petite pince est assez différente dans les 2 sexes, surtout comme forme. Le méropodite et le carpe sont très semblables, le premier est inerme, 2 fois aussi long que haut. Le rapport de la longueur totale de la pince à celle des doigts est 2·3 chez le ♂, près de 2·4 chez la ♀. Les proportions sont donc très voisines, mais la paume est beaucoup plus massive chez le ♂, où le rapport entre la longueur et la largeur de la pince est 2·6 seulement, alors qu'il atteint 3 chez la ♀. De plus, la petite pince s'atténue rapidement chez la ♀, où le doigt mobile est conique ; chez le ♂, au contraire, la largeur est seulement un peu moindre à l'articulation du doigt mobile, celui-ci est très élargi (2 fois aussi long que large, au lieu de 3 fois chez la ♀) et muni du côté interne d'un revêtement serré de courtes soies, qui manque à la ♀ (fig. 36 *b*, *c*).

Le rapport des deux petites pinces, chez la ♀ et le ♂, est seulement ⅚. L'une et l'autre portent de nombreuses et longues soies sur la surface interne de la paume et des doigts.

Sur la 2me paire, les segments 1 et 2 du carpe sont sensiblement égaux, le 1er étant toutefois un peu plus long (fig. 36 *d*).

Sur la 3me paire, le méropodite est robuste, près de 3 fois ½ aussi long que large, son apex inférieur se termine pas une forte saillie épineuse, son bord inférieur est étroit et glabre. Le carpe est aussi épineux à son apex inférieur, lisse et glabre également sauf un groupe de soies distales au bord supérieur. Le propodite est plus long que le carpe (rapport 1·4), il porte 7 épines mobiles et une forte rangée de soies au bord supérieur. Le dactyle est simple (fig. 36 *e*).

La 4me paire a les méropodites nettement épineux, dans les deux sexes. Les ischiopodites ont une épine mobile enfoncée, sur la 3me et la 4me paires (fig. 36 *e′*).

Le telson est peu atténué (rapport de sa base à son bord postérieur, 1·64, rapport de la longueur au bord postérieur, 2·8). La rame interne de l'uropode porte 5 épines, l'épine suturale de la rame interne est longue et droite (fig. 36 *f*, *g*).

L'*A. clypeatus* est très voisin de l'*A. pachychirus* Stimpson. Il s'en distingue cependant avec facilité par la forme toute spéciale du bord frontal. En outre, la petite pince de la 1re paire est bien différente chez l'*A. pachychirus*, et comme forme et comme taille. Le doigt mobile du ♂ est beaucoup plus élargi, en forme de losange irrégulier, garni de soies courtes et serrées de part et d'autre. La petite pince de la ♀ est beaucoup plus faible,

le rapport de ses dimensions dans les 2 sexes devenant inférieur à 0·45, au lieu de 0·8 chez l'*A. clypeatus.*

Sur la 2me paire, chez l'*A. pachychirus,* le 1er segment du carpe est plus long que le 2me (rapport 1·5). Enfin, la rame interne des uropodes n'est pas épineuse sur son bord libre.

Minikoi, Hulule Male Atoll, 5 sp. ♂ et ♀.

52. *A. pachychirus* Stimpson.

A. pachychirus Stimpson, *Proc. Ac. Philad.*, p. 30, 1860.

„ „ „ de Man, *Kükenthal Ergebn.*, p. 875.

Minikoi, Hulule Male Atoll, Goidu Atoll, Reef Naifaro, 27 sp. ♂ et ♀.

53. *A. frontalis* H. M.-Edwards.

A. frontalis H. M.-Edwards, *H. Nat. des Crust.* t. 2, p. 356.

„ „ „ *Règne animal,* fig. 2, pl. 53.

A. latifrons A. M.-Edwards, *J. Mus. Godefroy S.* 11, 1874.

„ „ „ de Man, *Arch. f. Naturg.* 5, p. 521, pl. 22, fig. 6, 1887.

Les types de "l'Alphée frontale" décrits par H. M.-Edwards et conservés au Museum de Paris se réduisent à quelques grandes pinces bien conservées, mais l'espèce a été très exactement figurée dans le Règne animal, observée et décrite depuis assez fréquemment pour ne laisser subsister aucun doute sur l'identité de l'*A. frontalis* et de l'*A. latifrons.* L'espèce est également synonyme du *Betæus utricola* Richters.

Fadifolu Atoll, Mahlos Atoll, Hulule Male Atoll, Minikoi, 18 sp. ♂ et ♀.

Groupe "insignis" H. Coutière.

Ce sous-groupe contient deux catégories assez distinctes de formes. Les unes conservent sur la grande pince le sillon alphéopsidien transversal et, la pince s'allongeant, conduisent insensiblement aux espèces du groupe "brevirostris" où ce sillon est présent. Ce sont les *A. insignis* Heller, *A. cristatus* H. C., *A. Lanceloti* n. sp., *A. bidens* Olivier, *A. gracilipes* Stimpson. Les autres se rattachent plus étroitement au groupe "*crinitus*" (sensu stricto) par la forme de leur grande pince, dépourvue de tout lobe ou sillon et de forme cylindrique, mais elles conduisent également au groupe "brevirostris," dont elles possèdent maints caractères, entre autres la gracilité des pattes de la 3me et de la 4me paire, la forme du telson et des uropodes. La disparition du sillon transverse de la paume est d'ailleurs, dans le groupe "brevirostris," aussi fréquente que sa persistance. Cette seconde catégorie d'espèces comprend l'*A. paracrinitus* Miers et une variété nouvelle "*Bengalensis,*" l'*A. alpheopsides* H. Coutière, et une forme nouvelle très voisine, l'*A. paralpheopsides.*

54. *A. insignis* Heller.

A. insignis Heller, *Sitz. K. K. Wiss. Wien,* 44, p. 269, pl. 3, fig. 17—18, 1861.

„ „ de Man, *Kükenthal Ergebn.*, p. 864, pl. 26, fig. 60, 1902.

„ H. Coutière, *Ann. Sc. Nat.* (6), p. 89, fig. 55.

Bien que l'*A. diadema* Dana soit très probablement synonyme de l'*A. insignis,* il vaut mieux, comme l'a fait de Man, réserver cette identification jusqu'au jour où le type de Dana sera réétudié plus minutieusement.

Minikoi, Goidu Atoll, Hulule Male Atoll, environ 40 sp. ♂ et ♀.

L'espèce se trouve également à Samoa, Mallicolo (Coll. Muséum, Paris), Mahé (Alluaud), Djibouti (Dr. Jousseaume, H. Coutière), et dans l'archipel Malais (de Man).

L'*A. diadema* Dana est des îles Sandwich.

55. *A. cristatus* H. Coutière.

A. cristatus H. Coutière, *Bull. Mus. Paris*, No. 7, p. 303, 1898.

„ „ „ *Ann. Sc. Nat.* (6), p. 89, fig. 56.

North Male Atoll, 2 sp. ♂ de petite taille.

Le type provient de Thursday Island (M. Lix).

56. *A. Lanceloti* n. sp. (Pl. LXXXIII. fig. 39).

Le rostre est saillant, bien distinct, séparé des voûtes orbitaires par un sillon, et aussi par une ligne très visible où la cuticule devient plus mince. Les voûtes orbitaires, arrondies et inermes, sont en effet plus molles et plus facilement dépressibles que dans la plupart des espèces.

L'article antennulaire médian est seulement un peu plus grand que le basal, le stylocérite à peu près égal à ce dernier. Le basicérite est fortement épineux à sa partie latéro-inférieure, le carpocérite dépasse le pédoncule antennulaire des $\frac{3}{4}$ de l'article distal ; le scaphocérite lui est presque égal en longueur, son écaille est large, et atteint presque, en avant, l'extrémité du pédoncule antennulaire (fig. 39).

L'article distal des maxillipèdes est ovale, 2 fois $\frac{1}{2}$ plus long que large. L'article précédent est aussi large que long.

Sur la 1re paire, la grande pince est un peu atténuée à son extrémité distale. Le rapport entre sa longueur totale et celle des doigts est égal à 3·35, sa largeur, et surtout sa hauteur, sont un peu supérieures à la longueur des doigts. La pince est lisse et entière, sauf un sillon transversal très marqué et une trace de sillon longitudinal, en avant du bord palmaire. Le bord inféro-interne du méropodite se termine par une forte épine, suivie de 4 autres plus faibles (fig. 39 *a*).

La petite pince est étroite, les doigts égalent la paume en longueur. Le rapport entre sa longueur totale et sa hauteur est voisin de 5. Le rapport entre la grande et la petite pince est 1·68 (fig. 39 *b*).

La 2me paire est assez longue, le méropodite atteint l'extrémité du carpocérite. Le second segment du carpe est un peu plus long que le 1er (rapport 1·12), les 2 suivants égaux, sensiblement moitié aussi longs que le 2me (fig. 39 *c*).

La 3me paire est très caractéristique. Le méropodite, un peu plus de 4 fois aussi long que large, et inerme à son apex inférieur distal, porte le long de son bord inférieur 3 fortes épines mobiles. Le carpe est inerme, le propodite, un peu plus long que le carpe (rapport 1·22), porte 5 épines mobiles, de longueur croissante, la dernière ayant la moitié de la longueur du dactyle. Celui-ci est simple, légèrement incurvé, très long (rapport du propodite au dactyle, 1·5) (fig. 39 *d*).

La 4me paire est semblable à la 3me, le méropodite porte même 4 épines au lieu de 3 à son bord inférieur. Les ischiopodites 3 et 4 sont munis d'une volumineuse épine enfoncée mobile.

Le telson est peu atténué à son extrémité distale, le rapport de sa base à son bord postérieur étant seulement 1·5. Il est un peu moins de 3 fois aussi long que large (bord postérieur). Les épines supérieures et postérieures sont longues et grêles, entre ces dernières on compte 14 soies plumeuses (fig. 39 *e*).

La rame externe de l'uropode est munie d'une forte épine suturale, la rame interne de 10 épines sur son bord libre.

North Male Atoll, Hulule Male Atoll, Goidu Atoll, 10 sp. ♂ et ♀.

57. *A. gracilipes* Stimpson.

A. gracilipes Stimpson, *Proc. Acad. Philad.*, p. 31, 1860.

Miladumadulu Atoll, Hulule Male Atoll, 15 sp. ♂ et ♀. L'espèce se rencontre également aux îles Sandwich, à Samoa, en N^lle^ Calédonie (Coll. du Muséum de Paris), à Mahé (Alluaud), à Djibouti (Dr. Jousseaume, H. Coutière), dans l'archipel Malais (de Man). Le type provient de Tahiti.

58. *A. paracrinitus*, var. *Bengalensis* n. (Pl. LXXXII. fig. 37).

Bien que l'espèce *A. paracrinitus* Miers ait été recueillie en Sénégambie, elle existe aussi à Djibouti, d'où j'ai rapporté de nombreux spécimens répondant en tous points à la description assez précise de Miers.

Je n'ai pas rencontré cette espèce dans la collection des Laquedives et Maldives, mais bien une variété, qui en diffère par quelques points seulement (fig. 37, 37′).

La petite pince, dans les spécimens typiques (fig. 38), porte du côté interne une épine très saillante protégeant le condyle articulaire ; on n'en trouve pas trace dans la variété *Bengalensis*. De même, l'épine terminant le bord inféro-interne du méropodite de la même pince a disparu, et celle du méropodite de la grande pince est très petite (fig. 37 *b*).

Sur la 2^me^ paire, le 1^er^ et le 2^me^ segments du carpe sont égaux (fig. 37 *c*). Chez les spécimens typiques, au contraire, comme l'indique la diagnose de Miers, le 1^er^ est notablement plus grand que le second (rapport de 1·75 à 1·85) (fig. 38 *a*). La 3^me^ paire est un peu différente comme proportions, le carpe est plus allongé et le propodite plus court que chez l'*A. paracrinitus* (rapport entre les longueurs du propodite et du carpe, 1·17 au lieu de 1·38 chez les spécimens typiques) (fig. 37 *d*).

L'ischiopodite est muni, comme chez l'*A. paracrinitus*, d'une épine enfoncée.

Le telson a la même forme, ses bords latéraux sont sinueux, le rapport de sa longueur à celle du bord postérieur est le même, voisin de 3. L'épine suturale de l'uropode externe est très oblique de dedans en dehors, la rame interne ne porte que quelques très faibles spinules sur son bord libre (fig. 37 *e*, *f*).

Minikoi, 2 sp. ♂ et ♀.

59. *A. alpheopsides* n. sp. (Pl. LXXXIII. fig. 40).

A. fasciatus Lockington (?), H. Coutière, *loc. cit.* p. 29.

Cette espèce est extrêmement voisine de l'*A. paracrinitus*. Elle s'en distingue par son rostre plus court et plus large, présentant en outre un détail très typique : à la face inférieure, le rostre présente, chez l'*A. paracrinitus*, comme dans la très grande majorité des espèces d'*Alpheus*, un épaississement important, duquel partent deux prolongements divergents, dirigés vers le bas, et venant embrasser le bec ocellaire presque à sa base,

de façon à fermer en avant l'espace compris entre les yeux et les voûtes orbitaires. Chez l'*A. alpheopsides* le rostre n'est nullement épaissi, et aucun prolongement ne s'étend de part et d'autre du bec ocellaire.

L'écaille antennaire est très grande chez l'*A. alpheopsides* et s'étend presque jusqu'à l'extrémité de l'épine latérale (fig. 40).

La grande pince est plus allongée (fig. 40 *b*). Le rapport entre sa longueur totale et sa hauteur, celle-ci mesurée dans le plan des doigts, est compris entre 3·59 et 3·7. Les doigts sont égaux en longueur à la hauteur de la paume, mais peuvent être plus longs, de sorte que le rapport entre la longueur de la pince et celle des doigts est compris entre 3·7 et 2·6. Ce dernier cas se rencontre chez l'un des types provenant de Djibouti, le plus souvent, le rapport est voisin de 3·4.

Hulule Male Atoll, 1 sp. ♀ mutilé.

L'espèce se rencontre aussi à Djibouti (Dr. Jousseaume, H. Coutière); son identification avec l'*A. fasciatus* Lockington demanderait à être vérifiée sur les types de cette dernière espèce, par suite des formes nouvelles décrites ici, qui s'en montrent également voisines.

60. *A. paralpheopsides* n. sp. (Pl. LXXXIII. fig. 41).

Cette nouvelle espèce est également très voisine des deux précédentes. Elle se distingue aisément de l'*A. alpheopsides* par le rostre aigu, naissant entre deux échancrures du bord frontal, presque égal à l'article antennulaire basal. Les articles de l'antennule sont relativement moins larges, plus cylindriques, le carpocérite ne dépasse guère l'antennule que de la moitié de l'article distal de celle-ci (fig. 41).

Le scaphocérite porte une écaille étroite, un peu plus courte que le pédoncule antennulaire, beaucoup plus courte que l'épine latérale, très aigüe, qui dépasse notablement le carpocérite.

La grande pince de la 1re paire est semblable à celle de l'*A. alpheopsides*, la petite pince est plus grêle, le rapport de sa longueur à sa hauteur est 5, alors qu'il ne dépasse pas 4·25 chez l'*A. alpheopsides*. Les doigts sont égaux à la paume comme dans cette dernière espèce, en longueur, et aussi en hauteur lorsqu'ils sont joints (fig. 41 *a*, *b*).

Les 2 premiers articles du carpe sur la 2me paire sont presque égaux, le 2me étant même légèrement plus long que le 1er. Chez l'*A. alpheopsides*, au contraire, le 1er est notablement plus long (rapport 1·57 à 1·85) (fig. 41 *c*, cf. 40 *c*).

La 3me et la 4me paire ont les mêmes proportions que chez l'*A. alpheopsides*, et l'ischiopodite est également dépourvu d'épine (fig. 41 *d*).

Le telson est beaucoup plus étroit que chez l'*A. alpheopsides* (rapport de la longueur à la largeur du bord postérieur, 1·89 au lieu de 1·56 dans l'espèce précédente), il a la même forme générale, tout en se montrant plus brusquement atténué dans sa moitié distale (fig. 41 *e*, cf. 40 *d*).

Cette espèce, comme la précédente, est très proche de l'*A. paracrinitus*, et surtout de sa variété *Bengalensis*. De même que dans ces deux formes, le rostre est pourvu de prolongements inférieurs ; mais la longueur de l'épine latérale du scaphocérite est plus grande, l'écaille antennaire plus étroite, les échancrures du bord frontal plus profondes, de part et d'autre du rostre.

Les proportions de la grande pince sont différentes, la 3me et la 4me paires sont dépourvues d'épines ischiales, le telson est plus étroit.

A ces différences communes s'ajoutent, pour la distinction avec l'*A. paracrinitus*, l'absence d'une épine sur la petite pince, au côté interne de l'articulation du doigt mobile, et les proportions différentes du carpe de la 2me paire.

L'*A. paracrinitus* var. *Bengalensis* en diffère aussi en particulier par les méropodites des pinces de la 1re paire très peu épineux, et par les proportions différentes de la 3me paire.

North Male Atoll, Suvadiva Atoll, 2 sp. ♀.

Groupe "brevirostris" de Man.

De Man, *Arch. f. Naturg.* I. pp. 497—533, 1887.

61. *A. Miersi* H. Coutière (Pl. LXXXIII., Pl. LXXXIV. fig. 42).

A. rapax, var. *Miersi* H. C., *Bull. Soc. Entom. de Fr.*, No. 7, p. 166, 1898.

Je dois préciser la diagnose un peu trop brève que j'ai donnée antérieurement pour cette espèce, qui pourrait presque aussi bien se ranger dans le sous-groupe "insignis" que dans le groupe "brevirostris."

Le rostre est aussi long que l'article antennulaire basal, prolongé en arrière par une carène assez nette, et séparé des voûtes orbitaires par un sillon large, à bords très peu indiqués. Le bord frontal présente une légère inflexion de part et d'autre, au point où il se raccorde avec les voûtes orbitaires.

Le stylocérite est un peu plus court que l'article antennulaire basal, l'article médian seulement un peu plus long que les 2 autres, qui sont égaux, l'article distal toutefois un peu plus long que le basal.

Le basicérite est épineux; le carpocérite dépasse le pédoncule antennulaire de la moitié de l'article distal. Le bord externe du scaphocérite est peu concave, son épine dépasse un peu le carpocérite; l'écaille est large, égale au pédoncule antennulaire ou légèrement plus longue (fig. 42).

L'article distal des maxillipèdes est 2 fois $\frac{1}{2}$ aussi long que le pénultième, celui-ci porte deux longues soies tubuleuses, fusiformes, semblables à celles qui se rencontrent chez l'*A. superciliaris*, précédemment décrit (fig. 42 *a*).

Sur la 1re paire, la paume de la grande pince porte une constriction transversale très marquée un peu en arrière du bord distal. Le rapport de sa longueur totale à celle des doigts est 2·85 environ, le rapport de cette même longueur à la hauteur est voisin de 2·5 (par suite de la torsion de la pince, la hauteur mesurée par la projection sur un plan des bords de la pince est plus faible que celle mesurée directement d'un bord à l'autre, c'est de cette dernière qu'il s'agit). Enfin, le rapport de la longueur à la largeur ou épaisseur de la pince est un peu plus grand que 3·8, voisin de 4. On voit que l'aplatissement de la paume est déjà très notable chez l'*A. Miersi*. Le bord inférieur et la plus grande partie de la face supéro-interne de la pince sont un peu rugueux, et munis de soies peu serrées. Le bord supéro-externe, échancré par le sillon transversal, est marqué par une crête peu élevée, mais ininterrompue depuis ce sillon jusqu'au carpe, et l'on trouve une autre crête de renforcement parallèle au bord inféro-interne (fig. 42 *b*).

Chez la ♀, la grande pince a même forme et mêmes proportions relatives, mais ses dimensions sont plus faibles, le rapport est 1·5 environ, entre deux spécimens ♂ et ♀ ayant la même longueur pour le céphalothorax (fig. 42 *c*).

La pince est 3 fois aussi longue que haute, 4 fois aussi longue que large ou épaisse. Elle est donc aussi aplatie que chez le ♂, mais plus grêle.

Le méropodite est court, son bord supérieur aboutit à un lobe très saillant, mais arrondi et non épineux, son bord inféro-interne est au contraire fortement épineux à son apex distal, et porte en outre 2 autres épines mobiles. Le rapport de la longueur à la hauteur est 1·85 (fig. 42 *b'*). Chez la ♀, ce rapport devient 2·3, l'armature épineuse restant la même.

La petite pince, chez la ♀, est étroite, les doigts un peu plus longs que la paume, coniques, effilés, joignant exactement. La pince entière a un peu plus de la moitié de la longueur du céphalothorax. Le méropodite est presque aussi long que la pince, le bord inféro-interne porte quelques épines mobiles, mais n'est pas épineux à son apex distal (fig. 42 *e*).

Chez les ♂, la petite pince est de taille très variable. Chez les uns, elle ne dépasse pas les $\frac{2}{3}$ du céphalothorax, les doigts sont égaux à la paume, et le doigt mobile en forme de "bec de *Balæniceps*," c'est à dire qu'il porte de part et d'autre deux crêtes saillantes se rejoignant en avant et au dessus de la pointe, garnies d'épaisses et courtes soies (fig. 42 *d*).

Chez d'autres, la petite pince, gardant la même forme et les mêmes proportions, atteint et dépasse la longueur du céphalothorax. Le méropodite ne participe que très peu à cet allongement, il s'épaissit surtout en hauteur, de même que la pince, et porte la même armature épineuse que chez la ♀ (fig. 42 *d'*).

Cette variation dans les dimensions de la petite pince est un cas de "dimorphisme des ♂" analogue à celui que l'on remarque chez les *Cambarus* (W. Faxon), *Saron gibberosus* et *marmoratus* (Borradaile, H. Coutière), *Eurypodius Latreillei*, *Palemon lar* (H. Coutière). De même que dans les espèces citées, il n'est nullement lié à l'accroissement de la taille et tient sans doute aux variations d'activité des glandes génitales.

La 2^{me} paire est aussi longue que la grande pince, chez les ♂. Le 2^{me} segment du carpe est très légèrement plus long que le 1er, les suivants plus courts, de longueur croissante du 3^{me} au 5^{me} (fig. 42 *f*).

La 3^{me} paire et la 4^{me} paire sont longues et grêles, elles portent une épine sur l'ischiopodite. Le méropodite de la 3^{me} paire est 5 fois aussi long que large, l'extrémité distale de son bord inférieur est légèrement mais nettement épineuse. Le propodite est plus long que le carpe (rapport 1·43) et porte 5 paires d'épines de longueur croissante. Le dactyle est long (presque la moitié du propodite), très faiblement courbé ; sa largeur à sa base égale sa hauteur, mais il n'est pas aplati, ni lancéolé (fig. 42 *g*).

Le méropodite de la 4^{me} paire est plus faiblement épineux que le précédent à son apex inférieur, le membre entier est plus court et plus grêle, avec des proportions très semblables.

Le telson est peu atténué, 1 fois $\frac{1}{2}$ seulement plus large à sa base qu'au bord postérieur, et un peu moins de 3 fois aussi long que ce bord. L'épine suturale de l'uropode est droite et forte, la rame interne porte une dizaine d'épines sur son bord libre (fig. 42 *h*, *i*).

L'*A. Miersi* est voisin de l'*A. rapax* Fabr., Sp. Bate, donc il sera question un peu plus loin, et aussi de l'*A. Djeddensis* H. Coutière[1]. Mais, dans cette dernière espèce, le basicérite est très faiblement épineux, la forme des pinces de la 1re paire un peu différente. La

[1] *Notes Leyden Mus.* XIX. note 23, p. 195, 1897.

grande pince, sur un des types ♂ de grande taille, est 3 fois aussi longue que haute, 6 fois aussi longue que large ou épaisse. La pince est donc plus grêle et plus aplatie.

Sur la petite pince, aussi longue que le céphalothorax, les doigts sont égaux à la paume et "*balæniceps*," comme chez l'*A. Miersi*, mais le rapport de la longueur à la hauteur est de 3·6 au lieu de 4·6 chez l'*A. Miersi*, où le doigt mobile est en outre plus distinctement lancéolé, et la pince de forme plus cylindrique. Le rapport de la longueur à l'épaisseur est en effet de 5 seulement chez l'*A. Miersi*, alors qu'il passe à 5·5 chez l'*A. Djeddensis* par suite de l'aplatissement palmaire.

Le rapport de la 2me paire au céphalothorax, égal à 1·7 chez l'*A. Miersi*, est seulement 1·5 chez l'*A. Djeddensis*.

Les méropodites 3 et 4 ne portent aucune trace d'épine à leur apex distal inférieur, et le dactyle est très nettement lancéolé et aplati, sa largeur maxima égalant 2 fois sa hauteur.

Enfin, la rame interne de l'uropode ne porte pas d'épines sur son bord libre.

L'*A. Miersi* est une espèce commune dans la collection des Laquedives et Maldives; Haddumati Atoll, Suvadiva Atoll, Kolumadulu Atoll, Mulaku Atoll; environ 45 exemplaires ♂ et ♀.

L'espèce se rencontre encore en Nlle Calédonie (Marie), à Mascate (Maindron), à Port-Molle, à Ceylon, au Japon (Br. Museum).

62. *A. rapax* Fabricius, Sp. Bate.

A. rapax Sp. Bate, *Macroures du Challenger*, pl. 99, fig. 1, p. 552.

Le bord frontal se raccorde aux voûtes orbitaires sans présenter d'inflexion; l'article antennulaire médian est plus de 1 fois ½ aussi long que le distal, le bord du scaphocérite est droit.

La grande pince est plus élargie que chez les *A. Miersi* et *A. Djeddensis*, le rapport de la longueur à la hauteur n'est guère que 2·46, elle est aussi plus aplatie, le bord inférieur étant presque tranchant dans sa moitié distale. La pince est 3 fois plus longue que les doigts.

Le méropodite est moitié aussi long que la pince, le rapport de sa longueur à sa hauteur est 3·6. Il est inerme à l'apex du bord inféro-interne, qui porte 4 épines mobiles.

Sur la petite pince, les doigts sont plus longs que la paume (rapport 1·33), béants, garnis de soies longues et fortes, mais non excavés sur la face interne comme chez l'*A. brevirostris* Olivier. Le doigt mobile n'est pas "*balæniceps*." Le méropodite a les ⅔ de la longueur de la pince et porte également 4 épines sur son bord inféro-interne.

Sur la 2me paire, le 2me segment du carpe est 2 fois plus long que le 1er.

Le méropodite de la 3me paire, inerme, est un peu plus grêle que dans les 2 espèces précédentes, le propodite est seulement un peu plus long que le carpe (rapport 1·13), le dactyle est très long (rapport du propodite au dactyle 1·65), régulièrement courbé, et nettement lancéolé, sa largeur maxima, mesurée au milieu de sa longueur, ne dépasse guère toutefois sa hauteur.

Le telson rappelle par sa forme l'*A. alpheopsides*; il en est de même des uropodes, dont l'épine suturale est très oblique vers l'extérieur.

Hulule Male Atoll, 1 ex. ♂.

L'espèce se rencontre également dans la mer Rouge, en Malaisie, à Hong-Kong, au Japon.

63. *A. barbatus* H. Coutière.

A. barbatus H. Coutière, *Bull. Mus.*, No. 6, p. 233, 1897.

„ „ *Ann. de sc. nat.* (6) p. 230, fig. 279—280, 1899.

Le type provient de Djibouti. L'espèce a été trouvée également à Mascate (Maindron). Elle présente beaucoup d'analogie avec l'*A. brevirostris* Olivier, par la forme de sa petite pince, mais les doigts n'en sont pas excavés du côté interne.

Hulule Male Atoll, 1 ex. ♂, dépourvu de sa grande pince.

Groupe "Edwardsi" de Man.

De Man, *Arch. f. Naturg.* I. pp. 497—533, 1887.

H. Coutière, *loc. cit.*, p. 352.

64. *A. parvirostris* Dana.

A. parvirostris Dana, *U. S. Expl. Exped.*, p. 551, pl. 35, fig. 3.

Miladumadulu Atoll, Goidu Atoll, Hulule Male Atoll, Reef Naifaro, environ 35 sp. ♂ et ♀.

Cette espèce est très largement distribuée dans tout l'Océan Indien et le Pacifique, depuis le Cap jusqu'aux îles Sandwich, la mer Rouge, le golfe de Bengale, l'archipel Malais, la N^lle^ Calédonie.

65. *A. hippothoë* de Man.

A. hippothoë de Man, *J. Linn. Soc., London*, vol. 22, p. 268, pl. 17, fig. 1—5.

Miladumadulu Atoll, Hulule Male Atoll, Kolumadulu Atoll, South Nilandu Atoll, 9 ex. ♂ et ♀.

Le type a été recueilli à Mergui (de Man), l'espèce se trouve encore dans l'archipel Malais (Coll. du Muséum), et à Djibouti (H. Coutière).

66. *A. pareuchirus* n. sp. (Pl. LXXXIV. fig. 43).

Cette espèce est voisine de l'*A. hippothoë* de Man, et aussi de la variété (?) de cette dernière espèce que le même auteur a décrite (*A. hippothoë* var? de Man, *Zool. Jahrb.* 9, p. 754, pl. 36, fig. 66, 1897).

Le rostre est bien marqué, et s'étend jusqu'en arrière des voûtes orbitaires sous forme d'une carène à bords étroits et arrondis. Le bord externe du scaphocérite est concave, l'écaille antennaire, assez étroite, ne dépasse pas le milieu de l'article antennulaire distal. Le basicérite porte une épine latérale assez forte, qui manque chez l'*A. hippothoë*, et se trouve dans la variété citée plus haut. Le carpocérite est plus long que le pédoncule antennulaire, qu'il dépasse de la moitié de l'article distal (fig. 43).

La grande pince de la 1^re^ paire rappelle l'*A. hippothoë* de Man, l'*A. euchirus* Dana, en ce que le bord palmaire inféro-interne n'est que très faiblement échancré à la naissance du doigt fixe, et simplement sinueux. Le bord supéro-externe, au contraire, porte une échancrure très nette, surmontée d'un lobe assez aigu. Sur la face supéro-interne, l'échancrure palmaire conduit dans une dépression triangulaire très faiblement marquée; du côté inféro-externe,

dans une dépression triangulaire aussi, mais beaucoup plus nette, et dont le bord inférieur notamment, parallèle au bord palmaire, est très accentué (fig. 43 *a*).

Cette pince est, de plus, allongée et grêle, sa longueur totale égale 3 fois sa hauteur, plus de 2 fois ½ la longueur des doigts, près de 5 fois son épaisseur. Ces proportions différencient nettement l'espèce de l'*A. hippothoë* d'une part, où la pince est plus trapue, moins de 2 fois ½ aussi longue que haute, un peu plus de 3 fois seulement aussi longue qu'épaisse. Chez l'*A. euchirus*, d'autre part, la pince est encore plus épaisse, presque cylindrique, rappelant le groupe "*crinitus*."

La petite pince n'est présente que sur un spécimen ♀. Elle est également allongée et grêle, le rapport de sa longueur à sa hauteur étant un peu supérieur à 5. Les doigts sont coniques, allongés, joignant exactement, plus longs que la paume (rapport 1·28) (fig. 43 *b*).

Le méropodite des 2 pinces est épineux à l'apex inférieur distal de son bord interne. Ce bord porte en outre 1—2 spinules mobiles.

Sur la 2^{me} paire, le 1er segment du carpe est très sensiblement égal au second, l'un et l'autre légèrement plus longs que les segments 3 et 4 réunis (fig. 43 *c*).

Sur la 3^{me} paire le méropodite est très grêle, près de 7 fois aussi long que large. À son apex inférieur distal il se termine par un bord nettement aigu, mais non épineux, et ne faisant aucune saillie visible. Le carpe a les ⅘ du propodite, le dernier porte 8 longues spinules mobiles. Le dactyle est simple, non aplati, il a le tiers du propodite en longueur. L'ischiopodite porte une épine enfoncée (fig. 43 *d*).

La 4^{me} paire a également le méropodite un peu aigu à son extrémité.

L'*A. hippothoë* de Man, l'*A. hippothoë var.* de Man, ont l'un et l'autre les pattes 3 et 4 beaucoup plus robustes, avec le méropodite nettement et fortement épineux. Il en est de même de l'*A. euchirus* Dana.

North Male Atoll, 4 sp. ♂ et ♀ ovées (le céphalothorax du plus grand ex. mesure seulement 4 mm., mais il ne s'agit pas, néanmoins, de jeunes de l'*A. hippothoë*, qui se montrent parfaitement distincts de l'*A. pareuchirus*).

67. *A. Bouvieri* A. M.-Edwards (Pl. LXXXV. fig. 44).

A. Bouvieri A. M.-Edwards, *Bull. Soc. Philom.*, p. 10, 1878.

A. Edwardsi Dana, Sp. Bate, non Audouin.

Je ne trouve pas de différences sensibles entre les spécimens des Maldives et le type de A. M.-Edwards provenant des Canaries.

La petite pince des ♂, dans cette espèce, porte sur le doigt mobile des crêtes sétifères se rejoignant avant la pointe, sur la face dorsale. Sur le spécimen ♂ de la collection, ces crêtes sont très faibles et ne se rejoignent pas dorsalement (fig. 44 *b*).

Minikoi, 3 sp. ♂ et ♀.

L'espèce se rencontre sur la côte occidentale d'Afrique, des Açores au Gabon (Dana, Sp. Bate, A. Bouvier, *le Talisman*, Pobéguin, Aubry-Lecomte), à Fernando-Noronha (Br. Museum). Également à Panama (Geay), (Mus. de Cambridge, Mass.).

68. *A. Bastardi* H. Coutière (Pl. LXXXV. fig. 45).

A. Bouvieri, var. *Bastardi*, H. Coutière, *Bull. Soc. Ent. de Fr.*, 5, p. 133, fig. 1a, 1898.

Cette espèce est bien distincte de la précédente. Le rostre est extrêmement réduit, et forme une très courte saillie obtuse en avant des voûtes orbitaires, que ne sépare aucun sillon. Chez l'*A. Bouvieri* le rostre est une crête bien distincte, s'étendant au delà des voûtes. L'écaille antennaire est plus large que chez l'*A. Bouvieri*, l'épine du scaphocérite le dépasse à peine. Dans l'une et l'autre espèce, le carpocérite dépasse l'extrémité du pédoncule antennulaire de toute la longueur de l'article distal (fig. 45).

La grande pince de la 1re paire est absolument semblable dans les deux espèces, et se distingue de celle des autres espèces du groupe en ce que la dépression de la face supéro-interne n'est pas triangulaire, mais en forme d'U, ses bords étant perpendiculaires à celui de la paume. Les bords de celle-ci sont parallèles.

La petite pince est un peu plus grêle chez l'*A. Bastardi*. D'ordinaire, on trouve sur celle du ♂ des crêtes sétifères, elles manquent sur le spécimen ♂ de la collection, dont les pinces sont d'ailleurs faibles et plus grêles que d'ordinaire (fig. 45 *a*).

Sur la 2me paire, le 1er segment du carpe est plus long que le 2me dans les deux espèces, mais le rapport est environ 1·76 chez l'*A. Bouvieri*, voisin de 2 chez l'*A. Bastardi*. Le rapport de la 2me paire au céphalothorax est égal à 1·55 dans cette dernière espèce, à 1·4 chez l'*A. Bouvieri* (fig. 45 *b*).

La 3me paire est également plus courte et plus forte chez l'*A. Bouvieri*. Le rapport de sa longueur à celle du céphalothorax est 1·27 seulement au lieu de 1·45 chez l'*A. Bastardi*. Ce raccourcissement porte sur tous les articles du membre dont les proportions relatives restant les mêmes. Le méropodite est seulement 3 fois ½ aussi long que large, au lieu de 4 fois ½ chez l'*A. Bastardi*.

Le propodite porte le même nombre de spinules, le dactyle est simple dans les deux cas. Le telson et les uropodes ne montrent aucune différence.

Minikoi, 1 sp. ♂.

L'espèce se rencontre aussi à Djibouti (H. Coutière), à Madagascar (Bastard), à Mascate (Maindron), à Panama (Geay). Il est possible qu'elle soit synonyme de l'*A. Haani* Ortmann = *A. minor* de Haan[1]. Le dessin qu'a donné de Man[2] de la région céphalique d'un type de Haan, conservé au musée de Leyde, se rapporte assez bien à l'*A. Bastardi* par son rostre très court. Le type présente toutefois une anomalie du rostre consistant en une dépression médiane entre les orbites. De plus, les écailles antennaires se rapportent plutôt à l'*A. Bouvieri*. Je possède de mon côté le dessin des deux faces de la grande pince, qui m'a été adressé par le Dr. Horst ; il ne laisse aucun doute sur la ressemblance très étroite que présente le type de l'*A. Haani* avec l'*A. Bouvieri* ou l'*A. Bastardi*, et l'une de ces espèces se trouverait ainsi jusqu'au Japon (fig. 45 *c*, *d*).

69. *A. Bouvieri*, var. *Hululensis* n. (Pl. LXXXV. fig. 46).

Je fais de cette nouvelle forme une variété de l'*A. Bouvieri* A. M.-Edwards ; elle en diffère par les points suivants. Le rostre est plus long, égal à l'article basal antennulaire, plus élargi à la base, et se raccorde aux bords des voûtes orbitaires par une courbe régulière. Chez l'*A. Bouvieri* une partie du bord frontal est en ligne droite, de part et d'autre du rostre (fig. 46).

[1] *Zool. Jahrb.* v. p. 472, 1890.

[2] *Zool. Jahrb.* x. pl. 36, fig. 64, 1898.

Sur la 2me paire, les 2 premiers segments du carpe sont presque égaux, le 1er seulement un peu plus long que le 2me (rapport 1·14) (fig. 46 *b*).

Enfin, la petite pince, chez le ♂, est dépourvue de toute crête sétifère sur le doigt mobile, alors qu'elle en possède chez l'*A. Bouvieri* ♂. Ce dernier caractère, comme je l'ai dit plus haut, peut toutefois s'atténuer beaucoup (fig. 46 *a*).

Hulule Male Atoll, 1 ex. ♂.

L'espèce se trouve aussi dans la mer Rouge (Dr. Jousseaume).

70. *A. pacificus* Dana (Pl. LXXXV., Pl. LXXXVI. fig. 47).

A. pacificus Dana, *U. S. Expl. Exped.* p. 542, pl. 34, fig. 5, 1852.

A. gracilidigitus Miers, *Zool. de l'"Alert,"* p. 287, pl. 25, fig. 32, 1884.

L'identité des deux espèces de Dana et de Miers ne me paraît pas douteuse, car on trouve, suivant l'âge et le sexe des spécimens, des variations dans la forme et les dimensions de la petite pince, assez étendues pour que l'on puisse songer à des espèces différentes, dans le cas où l'on ne disposerait que d'une série de formes peu étendue.

Le rostre est séparé des voûtes orbitaires par des sillons bien nets, à peu près parallèles, la surface de la pointe rostrale est régulièrement convexe, sans carène médiane. Le basicérite porte une forte épine, aussi longue que le stylocérite; le carpocérite dépasse le pédoncule antennulaire de toute la longueur de l'article distal de celui-ci, et l'écaille du scaphocérite est elle-même un peu plus longue que ce pédoncule (fig. 47).

Sur la grande pince de la 1re paire, la forme de la profonde incision du bord inféro-interne est très caractéristique; ses bords, sur la face inférieure de la pince, sont très nets, comme taillés à pic. L'échancrure du bord supéro-externe est surmontée d'un lobe à bord arrondi, mais proéminent et étroit. La ligne qui joint les 2 incisions partage très sensiblement en deux la longueur de la pince (fig. 47 *a*).

La petite pince est toujours plus épaisse et moins allongée chez les ♂. Ses dimensions sont assez régulièrement fonctions de la taille. Chez les jeunes, la petite pince est plus courte que le céphalothorax, ses doigts ne laissent qu'un léger intervalle lorsqu'ils sont clos, l'armature de soies qui les revêt est peu dense. Les proportions les plus fréquentes pour la petite pince sont alors les suivantes: le rapport entre la longueur totale et celle des doigts est 1·675, mais il peut s'élever jusqu'à 1·85, les doigts étant de très peu supérieurs à la paume. Le rapport entre la longueur totale et la hauteur reste toujours voisin de 3·35, double du premier (fig. 47 *b*).

Chez les spécimens âgés, la petite pince arrive à dépasser la longueur du céphalothorax, les rapports précédents deviennent respectivement 1·52 et 3, le second étant également le double du premier. La pince devient donc plus robuste, en même temps que l'intervalle entre les doigts clos augmente considérablement. L'armature de soies, du côté interne, devient très dense et très longue, au point de ne pas laisser apercevoir le bord du doigt fixe opposé à l'insertion des soies (fig. 47 *b'*).

Un caractère constant est la présence d'une légère constriction au bord inféro-interne, là où commence le doigt fixe.

Chez les ♀, cette constriction est toujours moins marquée, et la petite pince devient au plus égale à la longueur du céphalothorax. Le rapport de sa longueur à celle des doigts est

1·68, mais peut aller jusqu'à 1·77. Le rapport entre la longueur totale et la hauteur est 4·37 (fig. 47 *c*).

Chez les spécimens âgés, les 2 rapports précédents deviennent voisins de 1·52 et 4·95; les doigts croissent plus en longueur que la paume en épaisseur. L'intervalle entre les doigts reste toujours très faible, et l'armature de soies beaucoup moins dense que chez les ♂ (fig. 47*c'*).

Sur la 2me paire, le 1er segment du carpe est plus grand que le second (rapport 1·27 environ) (fig. 47 *d*).

Sur la 3me paire, le méropodite, le carpe et le propodite sont respectivement entre eux comme 3, 1·5, 2. L'ischiopodite porte une épine enfoncée; le dactyle est simple, régulièrement courbé, comprimé.

Minikoi, Mahlosmadulu Atoll, Goidu Atoll, Hulule Male Atoll. Une centaine de spécimens (dont les $\frac{7}{10}$ de Minikoi).

Espèce très répandue dans l'Océan Indien et le Pacifique, de Madagascar aux îles Sandwich, la mer Rouge, l'archipel Malais, l'île Campbell, etc.

71. *A. bis-incisus* de Haan, var. *Malensis*, n. (Pl. LXXXVI. fig. 48).

Je sépare sous ce nom quelques spécimens distincts de l'espèce japonaise, espèce parfaitement caractérisée par la forme de son rostre, bien figuré par de Haan. Le rostre est limité par deux profonds sillons divergents, il a la forme d'une triangle isocèle à surface plane donc la hauteur égale 1 fois $\frac{1}{2}$ la base. Les côtés sont très légèrement concaves, ou même entièrement droits; ils sont taillés à pic et surplombent un peu le sillon rostro-orbitaire. L'autre bord du sillon est beaucoup moins net et s'écarte du premier, de sorte que l'ensemble à l'ensemble de la lettre M renversée. La pointe du triangle, sur $\frac{1}{3}$ de sa hauteur, fait saillie en avant du bord frontal, et s'étend jusqu'au milieu ou jusqu'aux $\frac{3}{4}$ de l'article antennulaire basal. De part et d'autre de la pointe rostrale, le bord frontal s'étend presque en ligne droite, un peu oblique vers le haut, jusqu'au bord externe des voûtes orbitaires, qui paraissent ainsi tronquées en avant (fig. 48).

La grande pince de la 1re paire présente, comme toujours dans ce groupe d'espèces, une constriction sur chaque bord, sensiblement vers le milieu de la pince. Le lobe qui surmonte la constriction supérieure est aigu, bien distinct, mais non épineux; le lobe situé en arrière de la constriction inférieure est trigone, aigu, mais sa pointe est également mousse, bien que plus accentuée que celle du lobe supérieur. Les doigts sont toujours plus étroits que la portion palmaire, le rapport entre les hauteurs des 2 régions est voisin de 1·6. Le rapport entre la longueur totale et celle des doigts est voisin de 2·75 (fig. 48 *a*).

La petite pince est différente dans les 2 sexes, en ce qu'elle présente chez les ♂ les crêtes sétifères du doigt mobile si fréquentes dans le groupe "Edwardsi" (fig. 48 *b*).

La paume est toujours plus longue que les doigts, le rapport entre la longueur totale de la pince et celle des doigts est 2·27 environ, entre la longueur et la hauteur de la pince, 4·7 environ. Les crêtes sétifères ne s'étendent guère au delà du milieu du doigt mobile.

Sur les nombreux spécimens de l'*A. bis-incisus* que j'ai pu étudier, j'ai toujours trouvé des rapports un peu différents des précédents pour les dimensions des pinces de la 1re paire.

Le rapport de la longueur totale à celle des doigts, sur la grande pince, est seulement 2·5 (au lieu de 2·75), et la ligne qui joint les deux constrictions du bord palmaire passe

très sensiblement par le milieu de la pince. Le rapport entre le hauteur de la paume et celle des doigts ne dépasse pas 1·34 (au lieu de 1·6).

Sur la petite pince du ♂, le rapport de la longueur totale à celle des doigts est 1·9, les doigts étant très légèrement plus longs que la paume, et souvent plus faible (1·85).

Le rapport de la longueur à la hauteur est 4·33 environ.

Sur la petite pince de la ♀, le rapport entre la longueur totale et les doigts est voisin également de 1·85, le rapport de la longueur à la hauteur ne dépasse pas 4·12, la paume étant plus ovoïde que chez le ♂. En revanche, les doigts sont plus grêles, de sorte que la pince paraît plus atténuée à son extrémité distale.

C'est sur cette différence dans les proportions des pinces de la 1re paire que j'établis la var. *Malensis* de l'*A. bis-incisus* de Haan, la figure de cet auteur paraissant montrer que, sur la grande pince, la constriction des bords palmaires est sensiblement au milieu du membre.

Un autre point par lequel les deux formes diffèrent est la proportion entre les segments 1 et 2 du carpe de la 2me paire. Le rapport est environ 1·7 chez l'*A. bis-incisus*, comme sur la figure de De Haan, il est seulement 1·33 dans la var. *Malensis* (fig. 48 *c*).

South Male Atoll, Suvadiva Atoll, South Nilandu Atoll, Mulaku Atoll, 3 sp. ♂, 1 ♀ sans sa petite pince.

Les ex. de l'*A. bis-incisus* que j'ai examinés proviennent tous de Nlle Calédonie.

72. *A. bis-incisus*, var. *stylirostris*, n. (Pl. LXXXVI. fig. 49).

J'ai étudié un unique exemplaire ♂ de cette forme, distincte de l'*A. bis-incisus* par deux points :

Le rostre est beaucoup plus étroit, et s'élargit à peine à sa base, ses bords sont toujours aussi nets et tranchants, mais les sillons rostro-orbitaires sont moins marqués, leur bord externe étant à peu près virtuel. Le bord frontal a la même forme tronquée que chez l'*A. bis-incisus* (fig. 49).

La grande pince comme dans la var. *Malensis*. La petite pince est grêle, plus allongée que chez les spécimens typiques et absolument dépourvue de crêtes sétifères sur le doigt mobile, bien que le sp. soit un ♂ (fig. 49 *a*).

Le rapport entre la longueur totale et celle des doigts est 1·83, celui entre la longueur et la hauteur 4·85.

Le rapport entre les 2 premiers segments du carpe de la 2me paire est de 1·53.

Mulaku Atoll, 1 sp. ♂.

73. *A. Audouini* n. nom. (Pl. LXXXVII. fig. 52).

A. Edwardsi Audouin, H. Coutière, loc. cit., p. 486.

L'espèce figurée dans la description de l'Égypte et nommée par Audouin *Athanasus Edwardsi* a été l'une de celles qui ont donné lieu à plus de controverses, et sa synonymie est aussi riche que confuse. Cela tient vraisemblablement à ce que la forme figurée par Savigny est assez rare ; en tous cas, le dessin en est rigoureusement exact.

De Man a pensé avoir retrouvé la forme en question, il a figuré d'une part la pince (*Bull. Soc. Zool. de Fr.* Pl. IV. fig. 1, 1898), d'autre part la région céphalique (*Zool. Jahrb.* IX. Pl. 36, fig. 64 *e*, 1897) d'après des spécimens de Mergui. Cette dernière figure, à mon avis, ne

représente pas encore tout à fait le type de Savigny. De Man figure le rostre comme étroit, subulé, se prolongeant assez loin derrière les voûtes orbitaires, sans que toutefois ses bords soient nets et tranchants comme chez l'*A. bis-incisus.*

Or, sur la figure de Savigny, on voit avec la plus grande netteté que le rostre est en forme de cône coupé en long, obtus et notablement élargi à sa base, nullement subulé. (Il faut faire abstraction de l'erreur du dessin montrant les yeux à découvert; le type a dû être dessiné frais, et dans ce cas le bord orbitaire antérieur est assez transparent pour devenir à peu près invisible.)

La collection du Muséum renferme, provenant de Madras (Henderson), un beau sp. ♂ qui répond très exactement à cette forme du rostre (Pl. LXXXVI. fig. 50).

Quant à la grande pince de la 1re paire, elle est la même dans les deux cas, c'est à dire que les échancrures des bords palmaires sont bordées en arrière par un lobe, dont l'extrémité est épineuse (fig. 50 *a*, *a'*, *a''*).

Voici donc, à mon sens, deux formes déjà à distinguer dans l'espèce. L'une devra garder le nom de *A. Edwardsi* Audouin; quant à l'autre, décrite et figurée par de Man, que j'ai pu étudier aussi sur des spécimens provenant de Hong-Kong, il est assez curieux qu'elle corresponde au type parfaitement authentique et bien conservé de *A. chiragricus* H. M.-Edwards. Celui-ci est un beau sp. ♂ provenant des "mers d'Asie" (Dussumier) dont la grande pince est à droite, comme dans la description, et dont la petite pince, décrite comme ayant le doigt mobile "difforme et contourné sur lui-même," est simplement de forme "*balæniceps*" si courante dans le genre *Alpheus* (fig. 51).

Je propose donc de la distinguer sous le nom de *A. Edwardsi chiragricus.*

Ni l'une ni l'autre de ces formes ne sont représentées dans la collection des Maldives et Laquedives, mais elle en renferme une troisième, qui à mon sens doit être distinguée spécifiquement, possédant une très large distribution, très commune, et dont les deux précédentes sont très vraisemblablement dérivées. C'est cette espèce que jusqu'à présent j'ai toujours nommé l'*A. Edwardsi,* et dont je propose de changer le nom en celui de l'*A. Audouini.*

Elle diffère extrêmement peu des précédentes, et, en l'absence de tout critérium véritable, les dénominations de variétés et d'espèces que j'attribue aux unes et aux autres ont une pure valeur de mots.

Le rostre est semblable à celui de l'*A. Edwardsi.* C'est ce caractère, joint à la fréquence de l'espèce dans la mer Rouge et à l'incertitude de l'existence réelle du type de Savigny, qui m'avait fait identifier à l'origine les 2 espèces.

Sur la grande pince de la 1re paire, les lobes des bords palmaires externe et interne ne sont pas épineux, et se terminent simplement en ogive (fig. 52 *a*, *a'*, *a''*). Par rapport aux deux formes précédentes, cette disposition est primitive. Les sculptures de la paume, sur les pinces d'*Alpheus,* résultent des insertions musculaires qu'elles traduisent extérieurement. La cuticule ne peut suivre que leurs contours généraux, de sorte que les parties déprimées séparant les zones d'insertions ne peuvent qu'avoir leurs bords arrondis et lisses. S'il se superpose à cette disposition des crêtes de renforcement suivant les lignes d'effort maximum, ou des saillies épineuses aux points où les contacts externes sont le plus répétés, si une partie qui aurait pu se développer en un lobe s'atrophie en une pointe, comme un rameau devenant un aiguillon, ces complications sont d'ordre adaptatif et secondaire, par rapport au mécanisme général suivant lequel est modelée la grande pince chez *Alpheus,* à partir d'*Alpheopsis.*

C'est pourquoi je considère l'*A. Edwardsi*, et sa var. *chiragricus*, comme des formes dérivées de l'*A. Audouini*.

Sur la 2me paire, le rapport des 2 premiers segments du carpe est constant dans les 3 formes précitées, et voisin de 1·65. La 2me paire est 1 fois ½ plus longue que le céphalothorax (moyenne de 70 mesures) (fig. 50 *b*).

Miladumadulu Atoll, Goidu Atoll, Hulule Male Atoll, Reef Naifaro, Suvadiva Atoll, Minikoi, 14 sp. ♂ et ♀.

L'espèce se trouve dans toute la mer Rouge, l'Océan Indien, la Malaisie, et de la Nlle Zélande aux îles Sandwich.

74. *A. strenuus* Dana (Pl. LXXXVII. fig. 53).

A. strenuus Dana, *U. S. Expl. Exped.* p. 543, pl. 34, fig. 4, 1852.

Cette espèce est l'une de celles qui atteignent la plus grande taille dans le genre *Alpheus*, avec l'*A. brevirostris* Olivier. La présente collection en renferme qui mesurent 95 mm. (pinces comprises) et dont le céphalothorax a 24 mm. de long (la taille la plus élevée que j'aie pu constater est celle d'un ex. ♀ de l'*A. brevirostris* Olivier, dont le céphalothorax mesure 29 mm. et dont la longueur totale—la grande pince est absente—atteindrait probablement 120 mm.).

Le rostre se prolonge entre les yeux en une forte carène à bords mousses, un peu élargie en arrière, plus élevée que les voûtes orbitaires, dont un sillon profond la sépare de part et d'autre. Le bord frontal est arrondi, sauf une très légère saillie convexe entre le rostre et les bords des orbites. L'article antennulaire médian est 2 fois plus long que l'article distal, alors qu'il est seulement 1 fois ½ aussi long chez l'*A. Edwardsi* et l'*A. Audouini* (fig. 53).

Les pinces de la 1re paire diffèrent peu, comme forme, des espèces précédentes. Les échancrures des 2 bords palmaires sont bien marquées, les lobes qui les limitent en arrière tout à fait arrondis et obtus, elles conduisent dans deux dépressions, l'une triangulaire sur la face supéro-interne, l'autre rectangulaire sur la face inféro-externe. La ligne qui joint le fond des 2 échancrures palmaires coupe très sensiblement en deux parties égales l'axe longitudinal de la pince. Les doigts sont très robustes, leur hauteur, lorsque la pince est close, est à peine moindre que celle de la paume (rapport 1·23). Le doigt mobile est courbé suivant une circonférence très régulière s'étendant sur 145° environ, et dont le centre est à la naissance du processus molaire du doigt, un peu en arrière du bord antérieur de celui-ci. Le doigt se termine en pointe obtuse (fig. 53 *a*, *a'*).

Sur le doigt fixe, du côté supéro-interne, la cavité du doigt, recevant le processus ci-dessus indiqué est limitée par un volumineux lobe dont les bords rectilignes font un angle de 120°. La surface de ce lobe est lisse, il en est de même de la surface palmaire, qui ne porte aucune saillie dans l'espace compris entre la dépression triangulaire supérieure, le bord inférieur, et une ligne sinueuse indiquant la dénivellation entre la paume et les doigts.

Le rapport de la longueur totale de la pince à celle des doigts est 2·37 environ, la hauteur de la pince est très sensiblement égale à la longueur des doigts (celle-ci mesurée à partir de la saillie du condyle de la face inféro-externe jusqu'au bord antérieur, suivant l'axe de la pince), le rapport entre la hauteur de la paume et celle des doigts est 1·2.

La petite pince est très semblable à celle des *A. Edwardsi* et *A. Audouini* ♂, mais elle ne présente pas de différence sexuelle, les crêtes sétifères du doigt mobile étant toujours présentes et très marquées. Le rapport de sa longueur à celle des doigts est 2·2 environ, les doigts

mesurent 1 fois ½ la hauteur de la paume. Celle-ci montre, de façon très atténuée, la dépression de ses 2 bords, et aussi les espaces triangulaire et quadrangulaire correspondant à la dépression du bord supérieur, comme sur la grande pince (fig. 53 *b*). Ces détails sont également présents sur la petite pince des ♂ chez l'*A. Audouini*; dans la même espèce d'ailleurs, il n'est pas rare de rencontrer des sp. ♀ sur la petite pince desquels on trouve la trace très marquée des crêtes sétifères du doigt mobile.

La 2me paire est très caractéristique chez l'*A. strenuus*. Le rapport de sa longueur à celle du céphalothorax va d'ordinaire de 1·65 à 1·8, mais peut s'élever jusqu'à 1·9 ou 2 sur les sp. très adultes. Ce rapport est plus grand sur les sp. ♂ que chez les ♀. Les deux premiers segments du carpe sont presque égaux, le 1er étant toutefois toujours plus long (rapport 1 à 1·25).

Sur la 3me paire, le rapport entre la longueur et la largeur du méropodite est 3·7, cet article est ovale, lisse et inerme. L'ischiopodite porte une forte épine enfoncée. Le rapport du méropodite au propodite est 1·33, celui du propodite au carpe 1·25. Le propodite porte 6—7 paires de fortes épines mobiles; le dactyle est simple, tranchant, aucunement aplati ou lancéolé, il mesure ⅓ du propodite.

Le méropodite est plus grêle chez l'*A. Audouini* (rapport de sa longueur à sa largeur 4·33), le rapport du méropodite au propodite est aussi 1·3, celui du propodite au carpe 1·43 environ.

Le telson est plus large que chez l'*A. Audouini*. Le rapport entre la longueur et le bord postérieur n'est jamais supérieur à 2·5 et peut s'abaisser jusqu'à 2 chez les spécimens très adultes. Chez l'*A. Audouini*, ce rapport est 2·66. Le rapport entre les 2 bords, antérieur et postérieur, est aussi plus grand dans la dernière espèce (1·6 au lieu de 1·47), et le bord postérieur de courbure plus forte.

Goidu Atoll, Hulule Male Atoll, Kolumadulu Atoll, 3 sp., Minikoi, 32 ex. ♂ et ♀.

75. *A. strenuus* var. *angulatus*, n.

Un des exemplaires de l'*A. strenuus* se distingue nettement des autres par la forme de la 3me et de la 4me paires. Elles sont plus grêles que chez les spécimens typiques de même taille, le méropodite étant près de 5 fois aussi long que large. De plus, son bord inférieur est plus rectiligne que chez l'*A. strenuus*, et forme à l'apex antérieur un angle saillant dont on ne trouve pas trace chez l'*A. strenuus*. Le rapport de la 2me paire au céphalothorax est 1·8, les 2 premiers segments du carpe sont dans le rapport 1·12, et les caractères du rostre, de la petite et de la grande pince, du telson, sont aussi ceux de l'*A. strenuus*.

Hulule Male Atoll, 1 sp. ♀.

76. *A. leptochirus* n. sp. (Pl. LXXXVII. fig. 54).

Cette espèce ne correspond pas à l'*A. Edwardsi* var. *leviusculus* Dana, bien que la grande pince ait la même forme; il ne s'agit pas non plus de spécimens présentant une régénération "hypotypique" de cet appendice, fait que j'ai montré être relativement fréquent chez *Alpheus*.

Le rostre est étroit, presque aussi long que l'article antennulaire basal, à bords concaves. Il se continue jusqu'en arrière des voûtes orbitaires par une crête linéaire, presque tranchante, intersection de 2 plans adossés. Deux sillons bien marqués séparent le rostre des voûtes orbitaires, dont le bord antérieur est arrondi. Le rapport des 2 articles antennulaires médian et distal est 1·4 environ (fig. 54).

Le basicérite porte une épine latérale, le scaphocérite est un peu plus long que le pédoncule antennulaire et le carpocérite, son épine latérale est aigüe; son écaille assez étroite atteint le tiers distal du 3me article antennulaire. Les pédoncules des 2 paires d'antennes mesurent sensiblement le tiers de la longueur du céphalothorax, rostre compris. Chez l'*A. Audouini*, ce rapport est voisin de 3·5.

Les pinces de la 1re paire sont longues et grêles. Sur la grande pince, le rapport de la longueur totale à celle des doigts est 3·5, celui de la longueur totale à la hauteur varie de 3·5 à 3. Les bords de la paume sont parallèles, échancrés l'un et l'autre, mais la ligne joignant les 2 échancrures coupe l'axe longitudinal de la paume en 2 parties, qui sont dans le rapport de 1·33 au moins, de 1·48 au plus. La portion palmaire située en arrière des échancrures est donc beaucoup plus longue que chez les espèces précédentes (fig. 54 *a*). L'*A. Bouvieri* A. M.-Edwards, l'*A. Bastardi* H. Coutière ont une forme de la pince très analogue, dont les bords sont parallèles; le dernier rapport, indiquant la position des échancrures palmaires, est parfois même supérieur à 1·5 dans ces espèces, mais le rapport de la longueur à la hauteur est égal à 3 au plus. Elles se distinguent d'ailleurs de l'*A. leptochirus* par le carpocérite beaucoup plus long que le pédoncule antennulaire.

La dépression de la face inféro-externe de la paume, près de l'échancrure du bord externe, est de forme rectangulaire, son bord inférieur est très allongé et bien marqué. La dépression de la face supéro-interne est triangulaire, très allongée aussi, à bord inférieur sinueux et bien marqué. En un mot, ces sculptures en creux de la paume rappellent l'*A. Audouini* et l'*A. strenuus*. Au contraire, chez les *A. Bouvieri* et *A. Bastardi*, la face supéro-interne de la grande pince porte, en face de l'échancrure et la continuant, une simple dépression en forme d'U, à bords réguliers, de direction transversale.

Le méropodite de la grande pince est 3 fois aussi long que large; son bord inférieur interne porte 4 spinules et une forte épine distale.

La petite pince du ♂ porte sur le doigt mobile des crêtes sétifères qui manquent à la ♀ (fig. 54 *b*, *e*). Elle est beaucoup plus grêle que chez l'*A. Bouvieri*, le rapport de sa longueur à son épaisseur est 5 chez le ♂, voisin de 5·5 chez la ♀, le rapport de sa longueur à celle des doigts est de 2·2 environ dans les 2 sexes. Le méropodite est semblable à celui de la pince opposée.

La 2me paire est longue et grêle, le rapport de sa longueur à celle du céphalothorax est 1·7 chez un ♂, 2 chez une ♀ (où les 2 pattes sont asymétriques). Les 2 premiers segments du carpe sont égaux en longueur, parfois même le 2me est le plus long (fig. 54 *d*).

Les pattes 3 et 4 sont longues et très grêles, la 3me paire est 1 fois ½ aussi longue que le céphalothorax. L'ischiopodite est inerme, le méropodite également, près de 7 fois ½ aussi long que large. Le carpe a les ¾ de la longueur du propodite, celui-ci porte 6 longues et grêles spinules. Le dactyle est simple, non lancéolé; le rapport du propodite et du dactyle est 2·35 (fig. 54 *c*).

Le telson et les uropodes ont la même forme que chez l'*A. Audouini*.

L'*A. leviusculus* Dana est probablement, comme le dit cet auteur, une simple variété de l'*A. Bouvieri*, peut-être même un individu un peu anomal de cette espèce, mais il ne saurait se confondre avec l'*A. leptochirus*. C'est ce que montre le simple examen des figures de Dana, surtout celles relatives aux appendices céphaliques, à la 2me et à la 3me paires, plus courtes et plus massives.

Il ne s'agit pas non plus de jeunes de l'*A. strenuus*. Les spécimens ♀ de l'*A. leptochirus* portent des œufs, et se montrent de plus parfaitement distincts de l'*A. strenuus* de même taille.

North Male Atoll, Mahlosmadulu Atoll, 4 sp. ♂ et ♀ (sur le plus grand, une ♀, la longueur du céphalothorax ne dépasse pas 4 mm.).

La collection comprend en outre un certain nombre d'exemplaires trop mutilés pour être déterminables, ils appartiennent presque tous au groupe "Edwardsi," dont les espèces, très voisines, ne sont guère reconnaissables avec sûreté en l'absence des pinces de la 1re paire.

PLATE LXX.

Fig. 1. *Synalpheus neomeris* de Man, dactylopodite, × 130; 1′. var. *streptodactylus* H. C., dactylopodite, × 130.

Fig. 2. *Synalpheus Gravieri* H. C., région céphalique, × 30 (type); 2 *a*. petite pince, × 30; 2 *b*. patte de la 3me paire, × 30, et dactylopodite, × 100; 2 *c*. telson, × 54.

Fig. 3. Hybride (?) de *S. neomeris* et de *S. Gravieri*, région céphalique, × 30 (type); 3 *a*. dactylopodite, × 100.

Fig. 4. *Synalpheus Nilandensis* H. C., région céphalique, × 30 (type); 4 *a*. petite pince de la 1re paire, × 30; 4 *b*. carpe de la 2me paire, × 30; 4 *c*. patte de la 3me paire, × 30; 4 *c′*. patte de la 3me paire, dactylopodite, × 150; 4 *d*. telson, × 30.

Fig. 5. *Synalpheus Nilandensis oxyceros* H. C., détails de l'antenne, × 30 (type); 5 *a*. dactylopodite, × 150.

Fig. 6. *Synalpheus fossor* Paulson, bord frontal, × 30; 6 *a*. dactylopodite, × 150.

PLATE LXXI.

Fig. 7. *Synalpheus paraneomeris* H. C., spécimen à long rostre, × 30; 7′. spécimen à court rostre, × 30; 7 *a*. grande pince de la 1re paire, × 12; 7 *b*. petite pince de la 1re paire, × 30; 7 *c*. carpe de la 2me paire, × 30; 7 *d*. patte de la 3me paire, × 30; 7 *d′*. patte de la 3me paire, dactylopodite, × 150; 7 *d″*. patte de la 3me paire, autre forme, × 150; 7 *e*. telson, × 30.

Fig. 8. *Synalpheus biunguiculatus* Stimpson (?) de Man, spécimen de Djibouti, × 30; 8 *a*. grande pince de la 1re paire, × 12; 8 *b*. petite pince de la 1re paire, × 30; 8 *c*. patte de la 3me paire, × 30; 8 *c′*. patte de la 3me paire, dactylopodite, × 100; 8 *d*. telson, × 30.

Fig. 9. *Synalpheus biunguiculatus pachymeris* H. C. (type), × 30; 9 *a*. patte de la 3me paire, × 30; 9 *a′*. patte de la 3me paire, dactylopodite, × 100.

Fig. 10. *Synalpheus biunguiculatus exilipes* H. C. (type), × 30; 10 *a*. patte de la 3me paire, × 30; 10 *a′*. patte de la 3me paire, dactylopodite, × 100; 10 *a″*. patte de la 3me paire, dactylopodite, autre forme, × 150.

PLATE LXXII.

Fig. 11. *Synalpheus laticeps* H. C. (type), région céphalique, × 30; 11 *a*. petite pince de la 1re paire, × 30; 11 *a′*. petite pince vue d'en haut, détails, × 30; 11 *a″*. petite pince vue latéralement, × 54; 11 *b*. carpe de la 2me paire, × 30; 11 *c*. patte de la 3me paire, × 30; 11 *c′*. patte de la 3me paire, dactylopodite, × 100; 11 *d*. telson, × 30.

Fig. 12. *Synalpheus hastilicrassus* H. C. (type), région céphalique, × 30; 12′. carpocérite vu en dessous, × 30; 12 *a*. grande pince de la 1re paire, vue dans le plan des doigts, et en dessous, × 12; 12 *a*′. grande pince, méropodite et carpe, × 30; 12 *b*. petite pince de la 1re paire, × 30; 12 *c*. patte de la 3me paire, × 30; 12 *c*′. patte de la 3me paire, dactylopodite, × 100; 12 *d*. telson et uropodes, × 30.

Fig. 13. *Synalpheus acanthitelsonis* H. C. (type), région céphalique, × 30; 13′. autre sp. à long rostre, × 30; 13 *a*. méropodite et carpe de la grande pince, × 30; 13 *b*. petite pince de la 1re paire, × 30; 13 *c*. telson, × 54.

PLATE LXXIII.

Fig. 14. *Synalpheus tumido-manus* Paulson, région céphalique, × 30; 14 *a*. grande pince de la 1re paire, × 25; 14 *a*′. grande pince, méropodite et carpe, × 25; 14 *b*. petite pince de la 1re paire, × 25; 14 *c*, 14 *c*′. 3me paire, deux formes du dactylopodite, *c* × 150, *c*′ × 100; 14 *d*. telson, × 30.

Fig. 15. *Synalpheus Pescadorensis* H. C. (type), région céphalique, × 30; 15 *a*. grande pince de la 1re paire, × 12; 15 *b*. petite pince de la 1re paire, × 30; 15 *c*. dactylopodite de la 3me paire, × 100; 15 *d*. telson, × 30; 15 *e*. uropodes, × 30.

Fig. 16. *Synalpheus Stimpsoni Maldivensis* H. C. (type), région céphalique, × 30; 16 *a*. patte de la 3me paire; × 12, et dactylopodite, × 100; 16 *b*. carpe de la 2me paire, × 12; 16 *c*. maxillipède de la 3me paire, × 30; 16 *d*. telson, × 30.

PLATE LXXIV.

Fig. 17. *Alpheus paradentipes* H. C. (type), région céphalique, × 30; 17 *a*. grande pince de la 1re paire, × 30; 17 *b*. petite pince de la 1re paire (♂), × 30; 17 *b*′. petite pince de la 1re paire (♀), × 30; 17 *c*. carpe de la 2me paire, × 30; 17 *d*. patte de la 3me paire, × 30.

Fig. 18. *Alpheus Hailstonei* H. C. (type), spécimen ♂, région antérieure, × 30; 18 *a*. grande pince, face inféro-externe, × 30; 18 *b*. petite pince, face inféro-externe, × 30; 18 *c*. patte de la 3me paire, × 30.

Fig. 19. *Alpheus sp.* (?), région céphalique, × 30; 19 *a*. carpe de la 2me paire, × 30.

PLATE LXXV.

Fig. 20. *Alpheus Seurati* H. C., spécimen ♂ (co-type), × 12; 20′. spécimen ♂ (région céphalique), × 30; 20 *a*. grande pince de la 1re paire, face inféro-externe, × 12; 20 *a*′. grande pince de la 1re paire, détails de l'extrémité, × 30; 20 *b*. 2me paire, carpe, × 30; 20 *c*. 3me paire, × 30; 20 *d*. telson, × 30; 20 *e*. uropodes, × 30.

Fig. 21. *Alpheus idiocheles* H. C., spécimen ♂ (type), × 12; 21′. spécimen ♂, région céphalique, vue en dessus, × 30; 21″. spécimen ♂, région céphalique, vue latéralement, × 30; 21 *a*. grande pince de la 1re paire, × 12; 21 *a*′. grande pince de la 1re paire, détails de l'extrémité, × 30; 21 *b*. telson, × 30; 21 *c*. uropodes, × 30.

PLATE LXXVI.

Fig. 22. *Alpheus paragracilis* H. C. (co-type), région céphalique, × 30; 22 *a*. maxillipèdes III, × 30; 22 *b*. grande pince de la 1re paire, × 12; 22 *c*. petite pince de la 1re paire, × 12; 22 *d*. 2me paire, carpe, × 30; 22 *e*. 3me paire, × 30; 22 *f*. telson, × 30; 22 *g*. uropodes, × 30.

Fig. 23. *Alpheus microstylus* Sp. Bate, sp. ♂, région céphalique, × 30 ; 23 *a*. petite pince de la 1re paire ♂, × 12 ; 23 *a'*. petite pince de la 1re paire ♀, × 12 ; 23 *b*. 2me paire (le trait indique la longueur du céphalothorax), × 12 ; 23 *c*. 3me paire, × 12.

Fig. 24. *Alpheus Lutini* H. C., région céphalique, × 30, sp. ♂ (co-type) ; 24 *a*. grande pince de la 1re paire, × 12 ; 24 *b*. petite pince de la 1re paire, × 12 ; 24 *c*. 2me paire, × 12 ; 24 *d*. 3me paire, × 12 ; 24 *e*. telson, × 30.

PLATE LXXVII.

Fig. 25. *Alpheus phrygianus* H. C., sp. ♂ (co-type), région céphalique, × 30 ; 25 *a*. grande pince de la 1re paire, × 12 ; 25 *a'*. grande pince de la 1re paire (détails de l'extrémité), × 30 ; 25 *b*. petite pince de la 1re paire, × 12 ; 25 *c*. 2me paire, × 12 ; 25 *d*. 3me paire, × 12 ; 25 *e*. telson, × 30.

Fig. 26. *Alpheus Dancæ* H. C., sp. ♀ (type), × 30 ; 26 *a*. petite pince de la 1re paire, × 12 ; 26 *b*. 2me paire, × 12 (le trait indique la longueur du céphalothorax) ; 26 *c*. 3me paire, × 12 ; 26 *d*. telson, × 30.

Fig. 27. *Alpheus ovaliceps* H. C., sp. ♂ (type), × 30 ; 27 *a*. maxillipèdes III, × 21, et détails d'une soie, × 100 ; 27 *b*. grande pince de la 1re paire, × 12 ; 27 *b'*. grande pince de la 1re paire (détails), × 30 ; 27 *c*. petite pince de la 1re paire, × 21 ; 27 *d*. 2me paire (carpe), × 21 ; 27 *e*. 3me paire, × 21.

PLATE LXXVIII.

Fig. 28. *Alpheus styliceps* H. C., sp. ♂ (type), × 30 ; 28 *a*. grande pince de la 1re paire, × 12 ; 28 *a'*. méropodite et carpe (détails), × 30 ; 28 *b*. petite pince de la 1re paire (vue latéralement), × 21 ; 28 *b'*. petite pince de la 1re paire (vue en dessus), × 21 ; 28 *c*. 2me paire (carpe), × 30 ; 28 *d*. 3me paire, × 30.

Fig. 29. *Alpheus bucephalus* H. C., sp. ♂ (co-type), × 30 ; 29 *a*. grande pince de la 1re paire, × 12 ; 29 *a'*. grande pince de la 1re paire, carpe et méropodite, × 12 ; 29 *b*. petite pince de la 1re paire (♂), × 21 ; 29 *b'*. petite pince de la 1re paire (♀), × 21 ; 29 *c*. 2me paire (le trait indique la longueur relative du céphalothorax), × 21 ; 29 *d*. 3me paire, × 21 ; 29 *d'*. 4me paire, détails du méropodite, × 21 ; 29 *e*. telson, × 30 ; 29 *f*. uropodes, × 21.

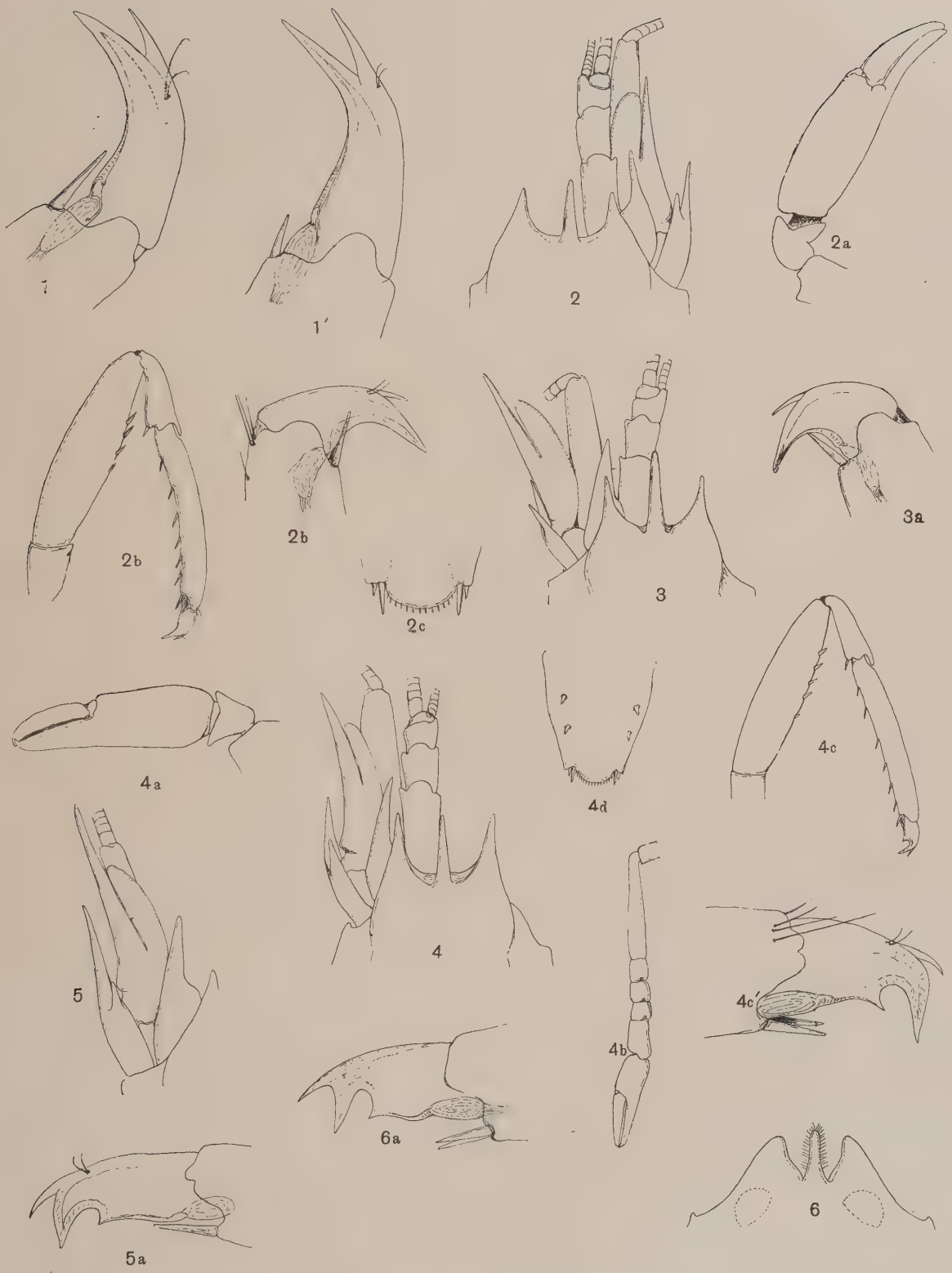
Fig. 30. *Alpheus bradypus* H. C., sp. ♂ (type), × 30 ; 30 *a*. petite pince de la 1re paire (♂), × 30 ; 30 *a'*. petite pince de la 1re paire (♀), × 30.

PLATE LXXIX.

Fig. 30 *b*. *Alpheus bradypus* (suite), 2me paire (carpe) (♀), × 30 ; 30 *b'*. 2me paire (carpe) (♂), × 30 ; 30 *c*. 3me paire, × 30 ; 30 *d*. telson, × 21 ; 30 *e*. uropodes, × 21.

Fig. 31. *Alpheus aculeipes* H. C., sp. ♂ (co-type), × 12 ; 31 *a*. région céphalique, × 30 ; 31 *a'*. détails des antennes sur un autre spécimen, × 30 ; 31 *a''*. détails des antennes sur un 3me spécimen, × 30 ; 31 *b*. petite pince de la 1re paire (♂), × 21 ; 31 *c*. petite pince de la 1re paire (♀), × 21 ; 31 *d*. 3me paire, × 30 ; 31 *d'*. 3me paire, détails du méropodite, × 100 ; 31 *d''*. 3me paire, dactylopodite, × 100 ; 31 *e*. 4me paire, méropodite, × 30 ; 31 *f*. telson, × 30 ; 31 *g*. uropodes, × 30.

Fig. 32. *Alpheus paraculeipes* H. C., sp. ♂ (co-type), × 30 ; 32 *a*. maxillipèdes III, × 30 ; 32 *b*. grande pince de la 1re paire, × 12 ; 32 *b'*. grande pince de la 1re paire (carpe et méropodite), × 12.



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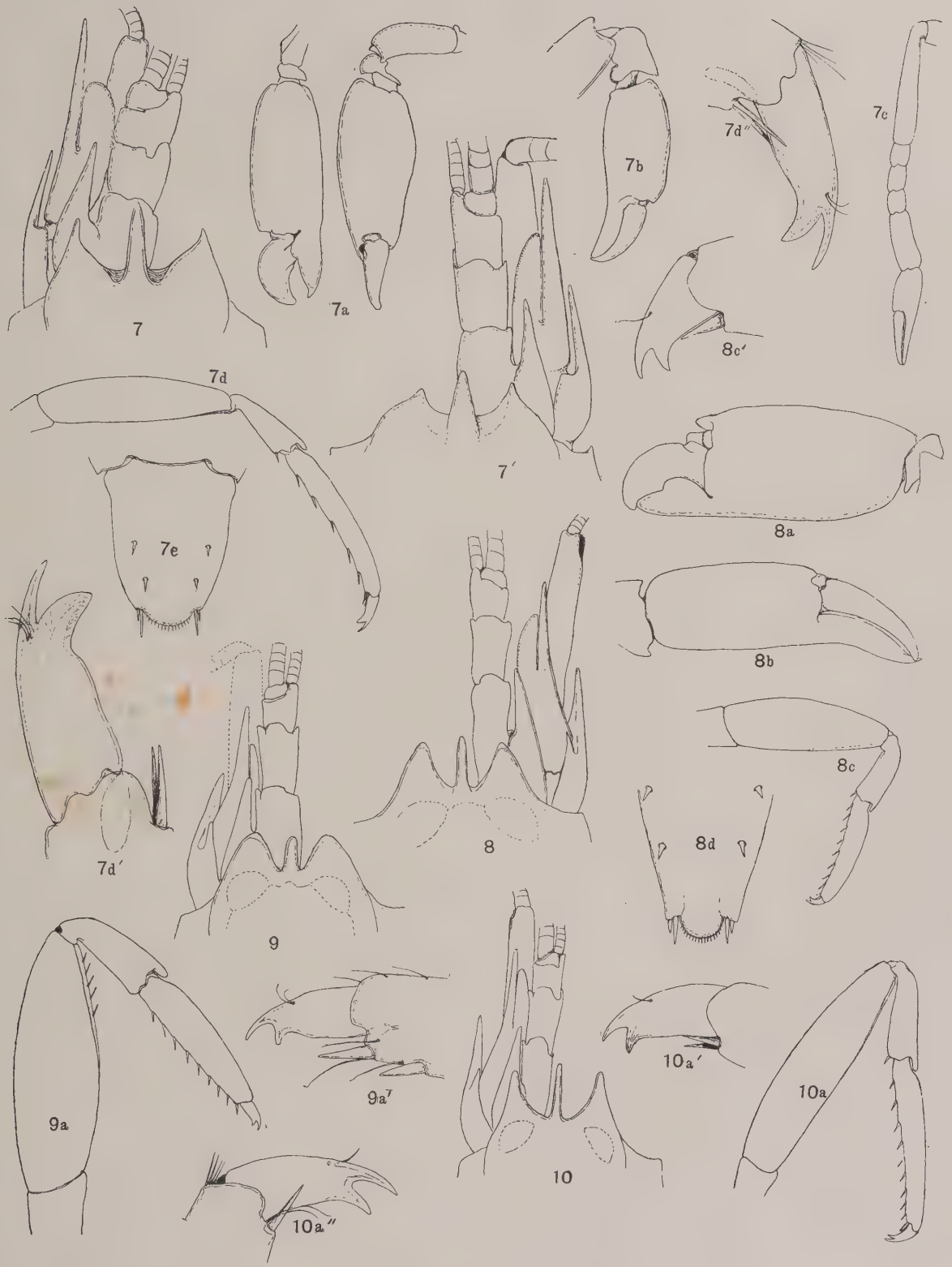

H. C. del.

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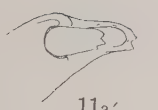
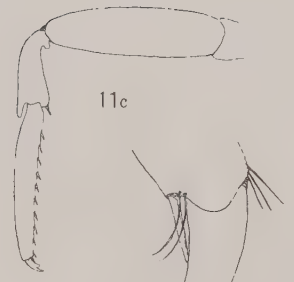
11b

11



11a′

11a″



11c

11c′

11d

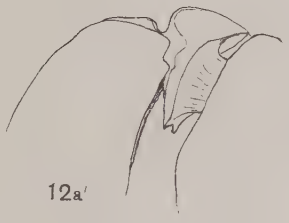
12a

12

12′

12c′

12b



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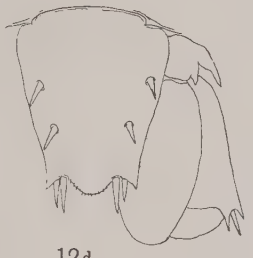

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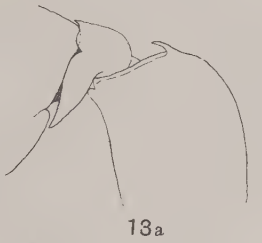

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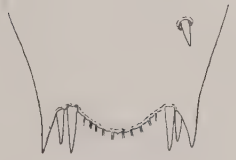

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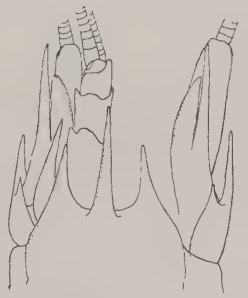

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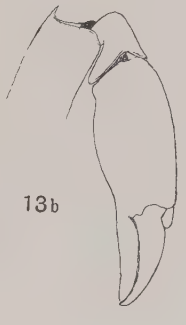

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H. C. del.

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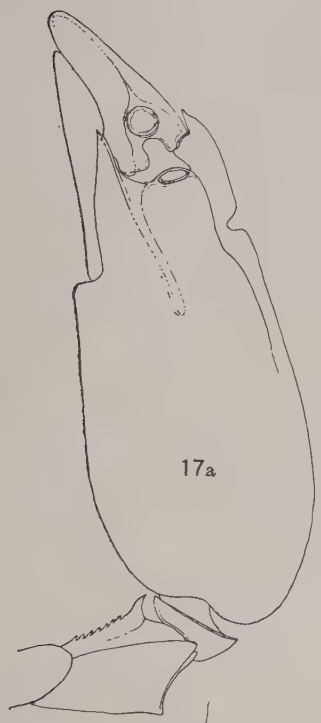

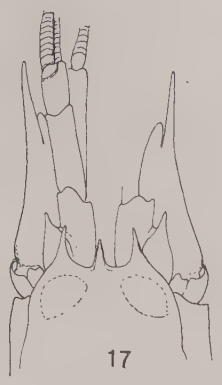

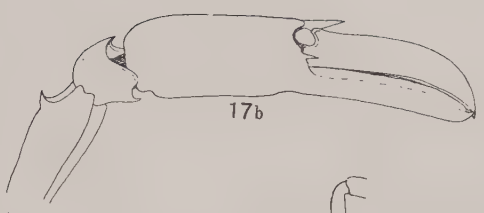

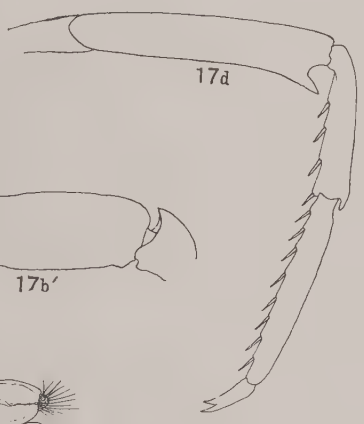

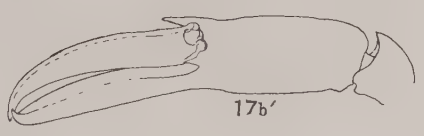

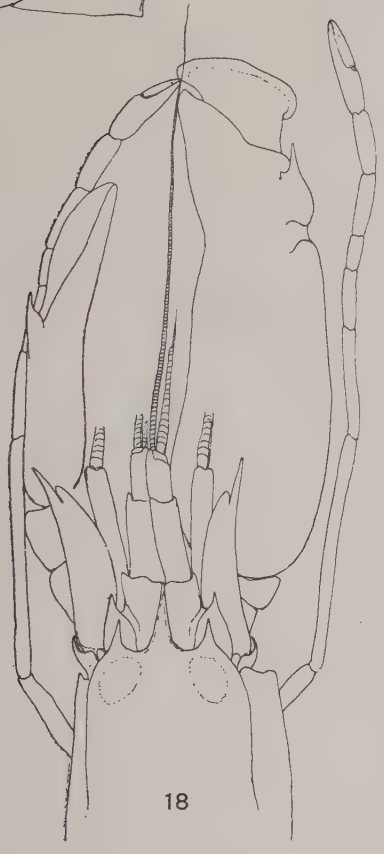

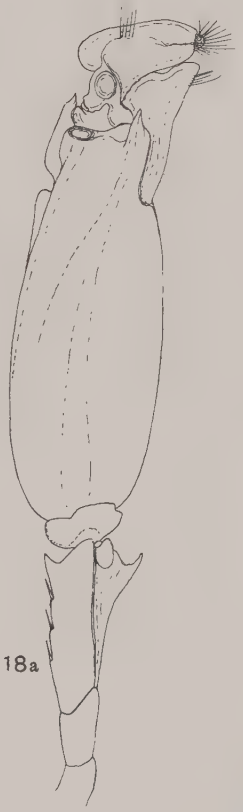

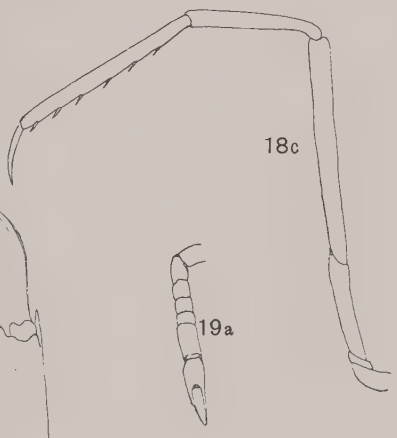

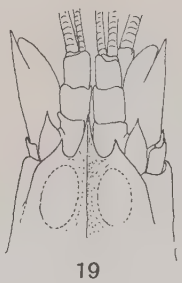

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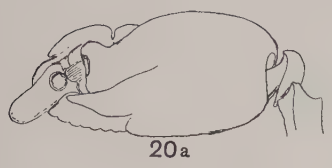

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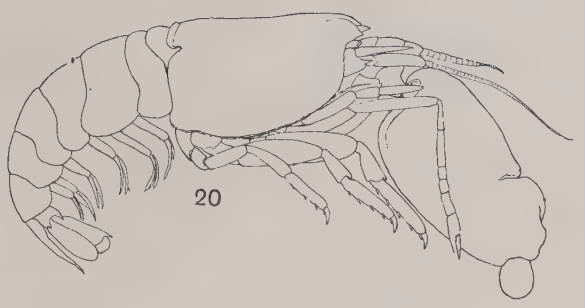

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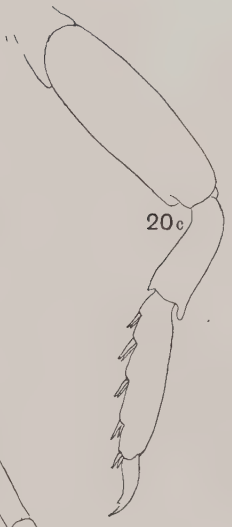

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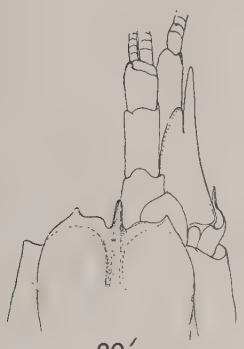

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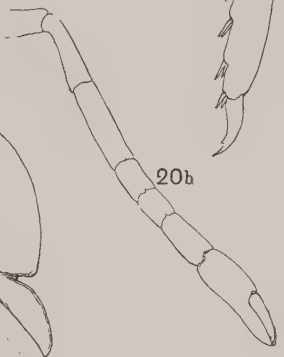
20a′

20á



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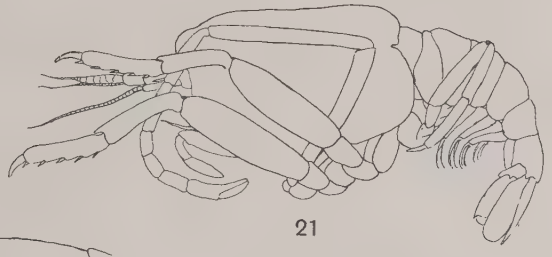

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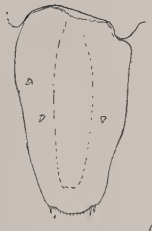

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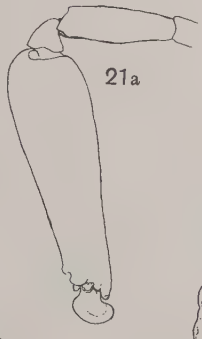

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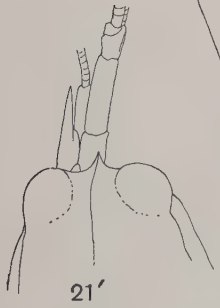

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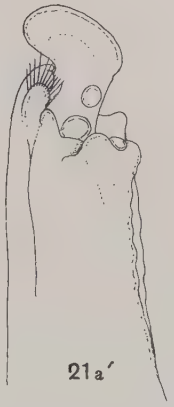
21a′



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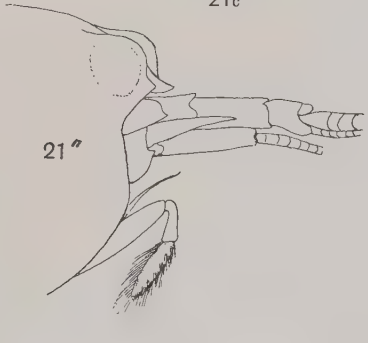

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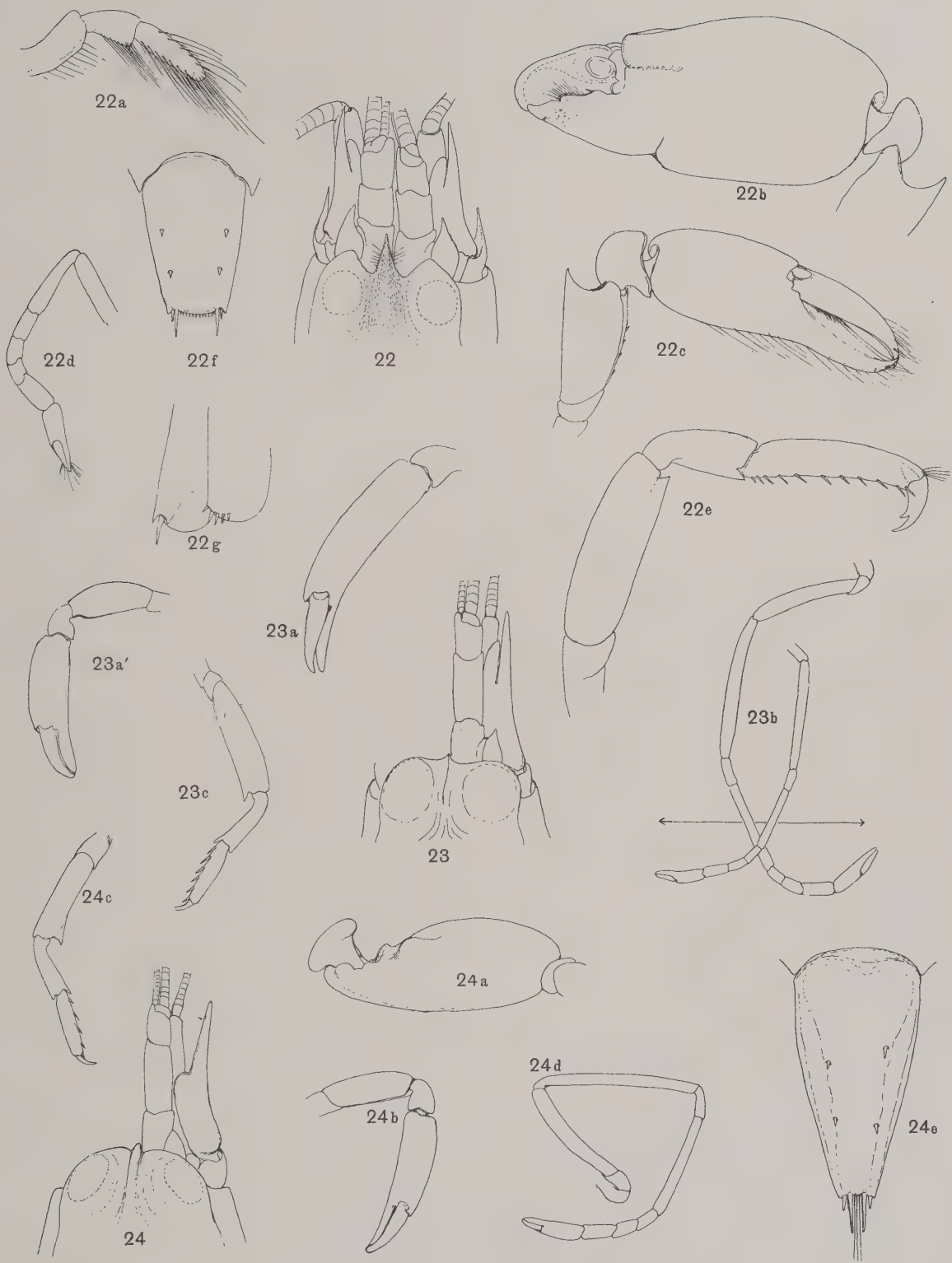

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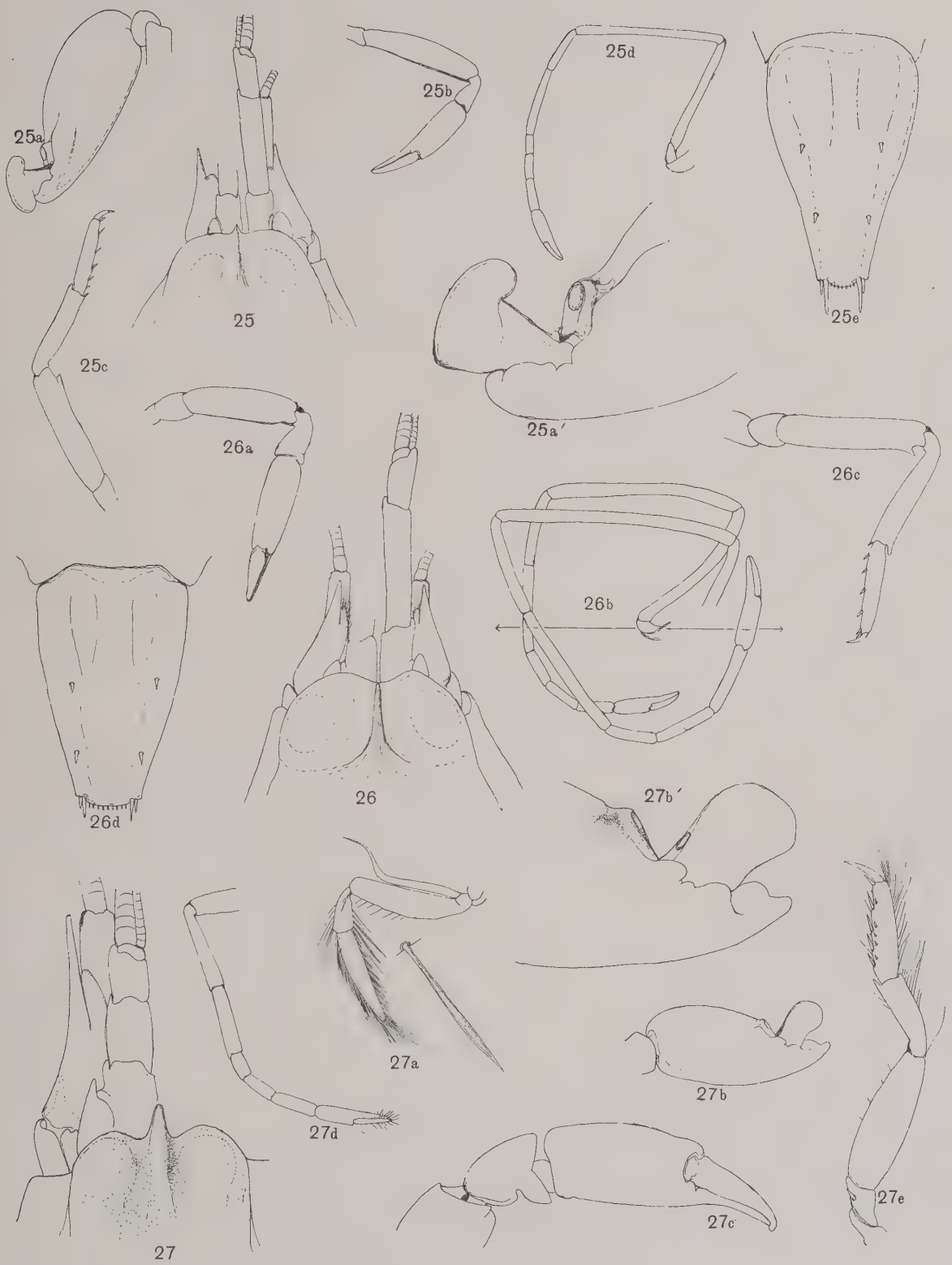

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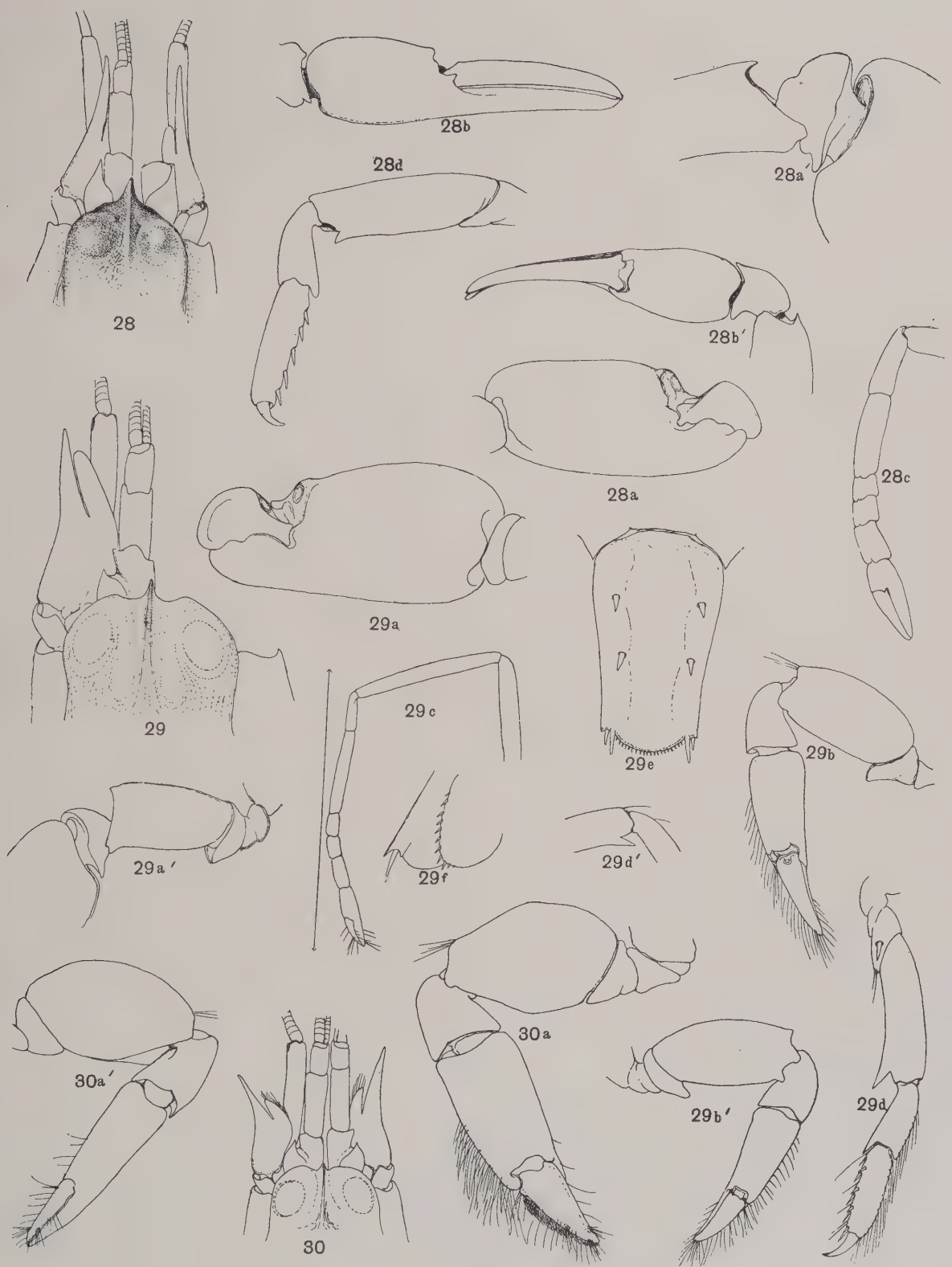

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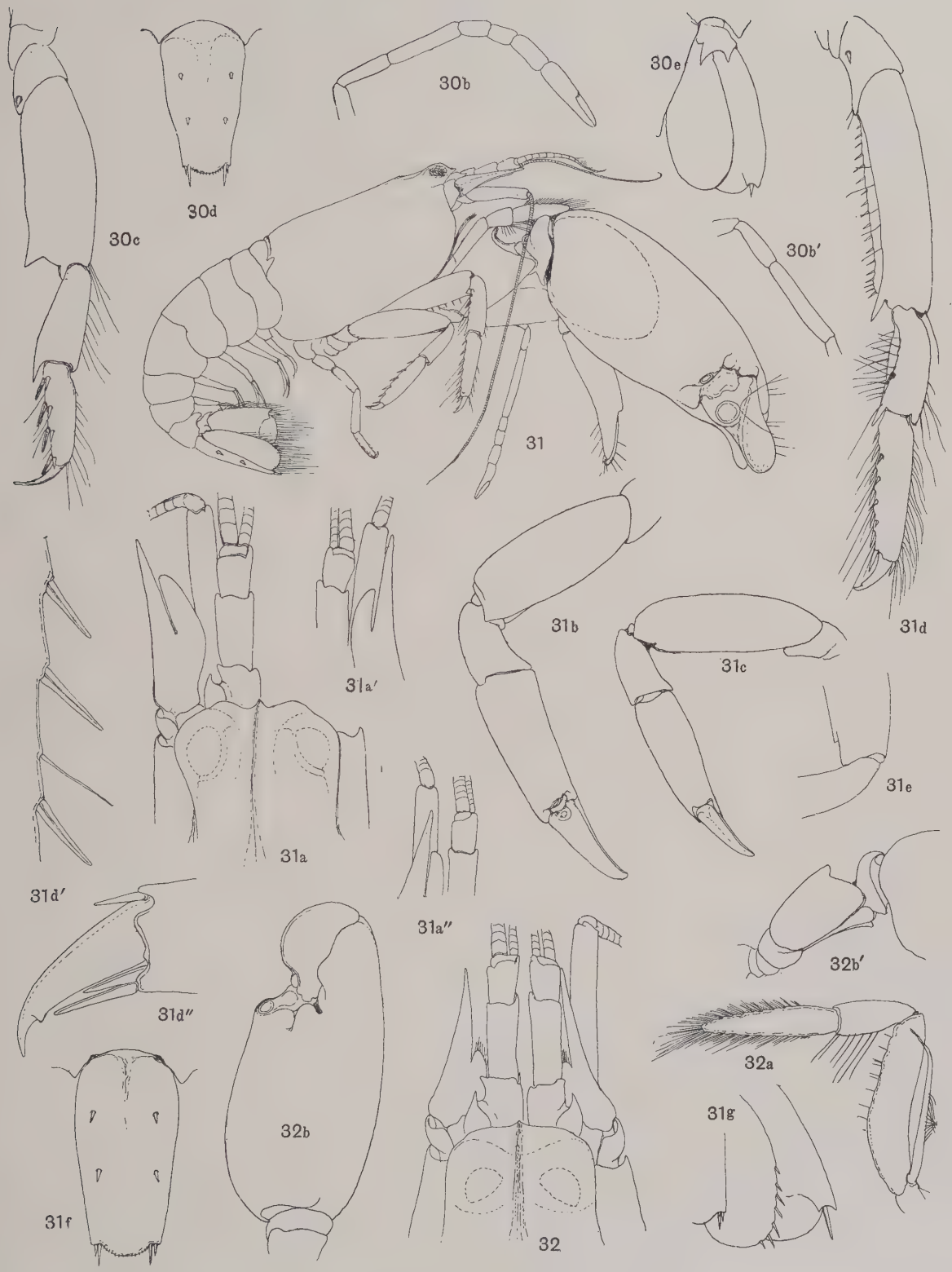

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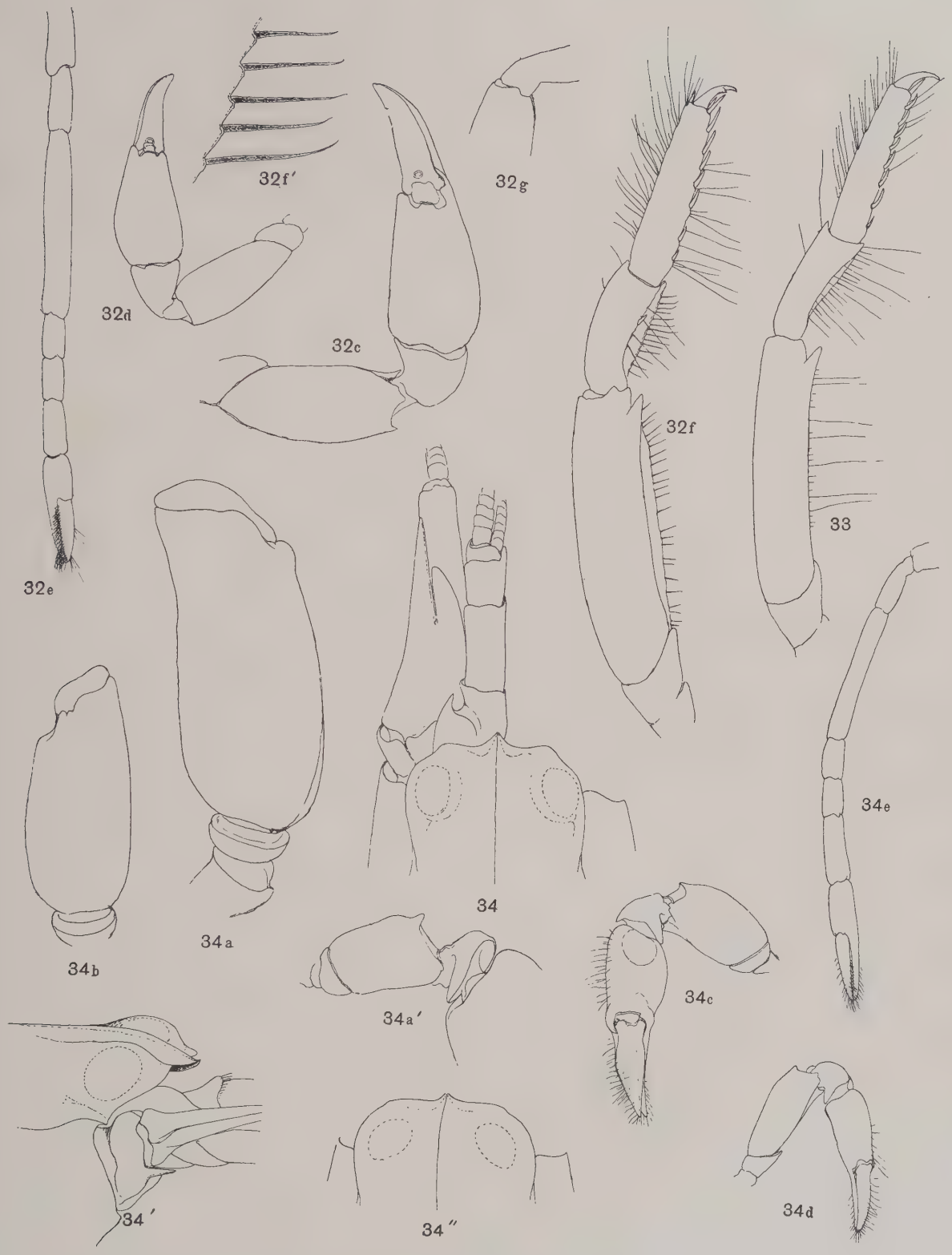

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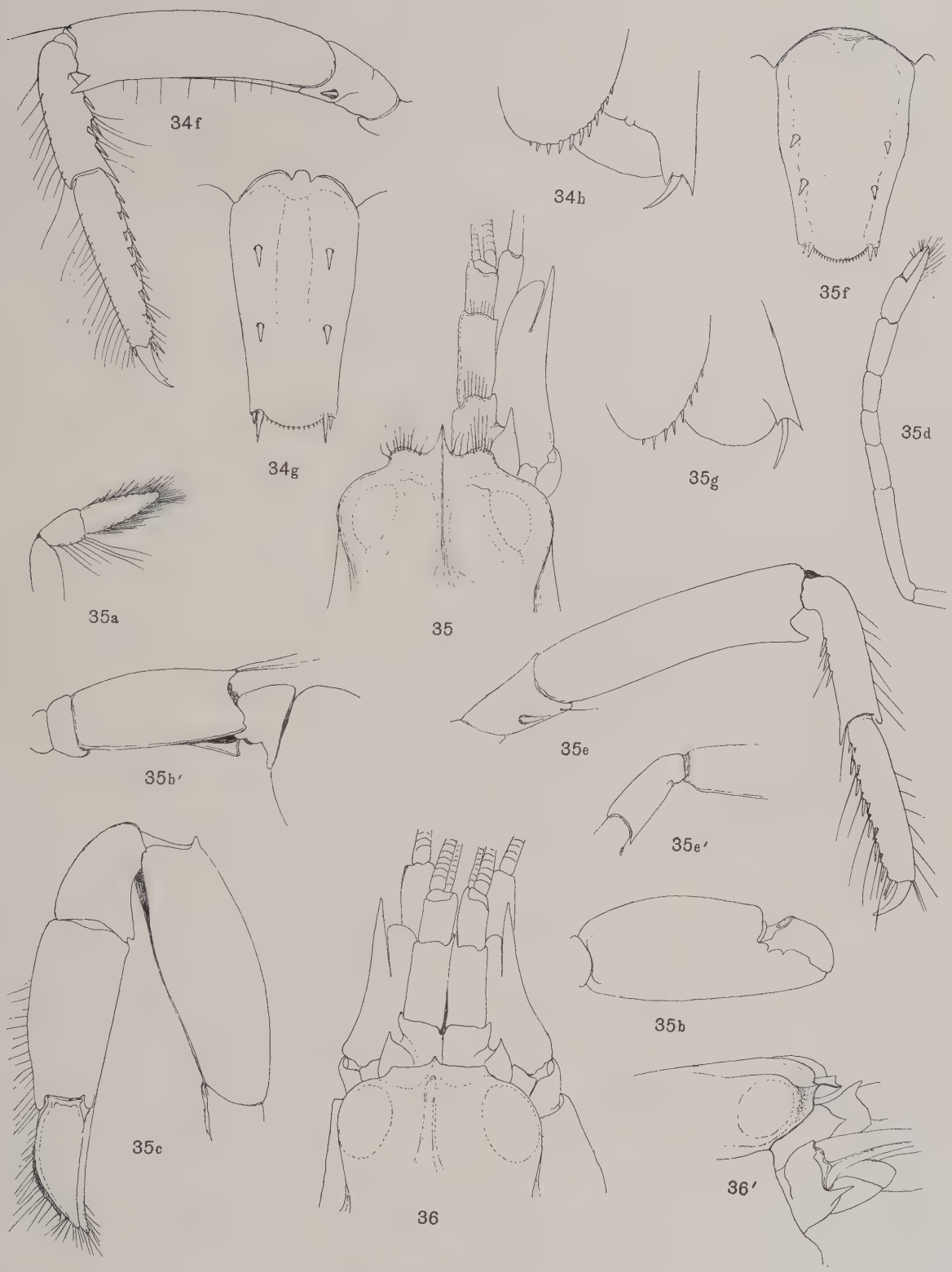

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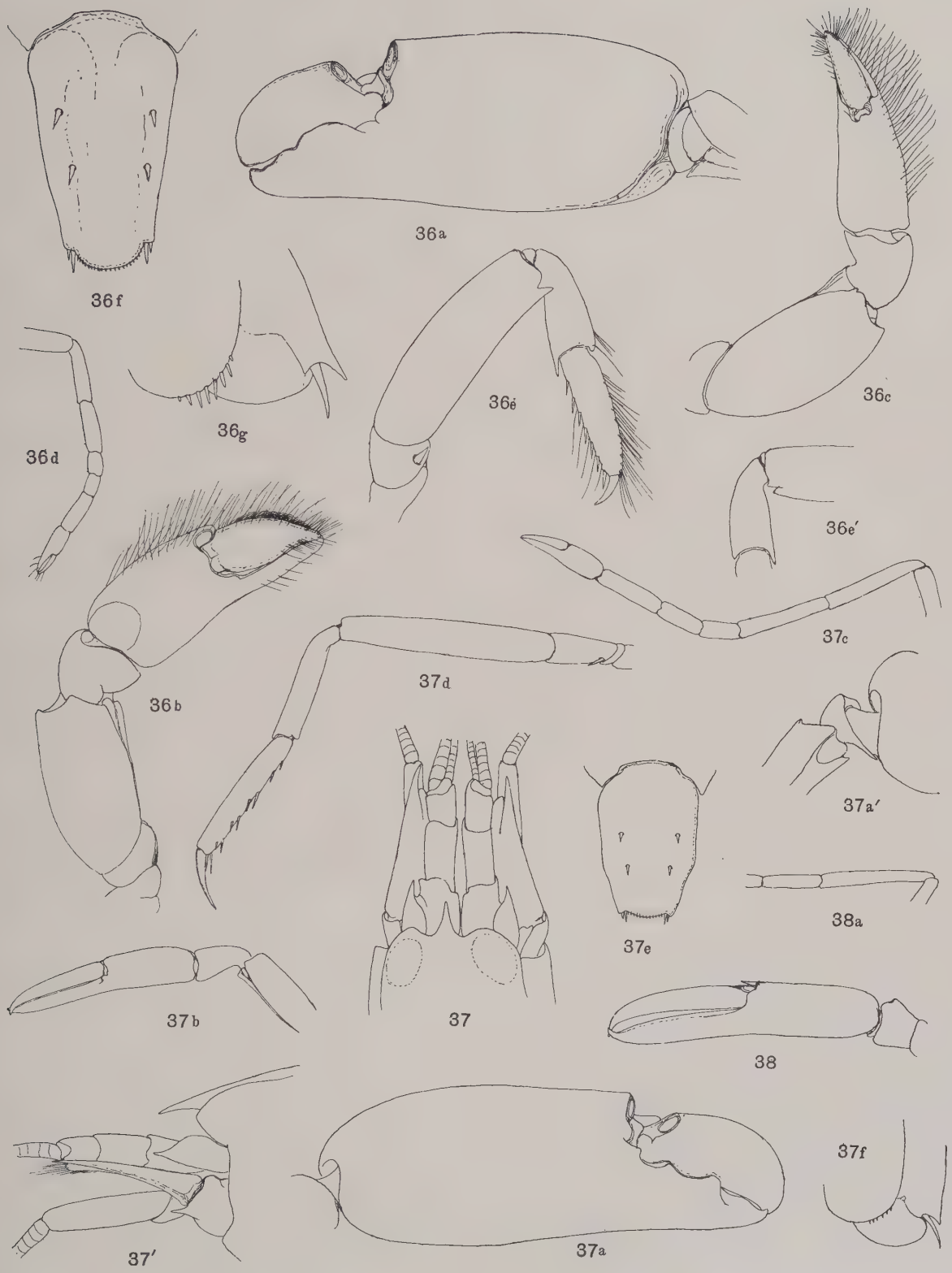

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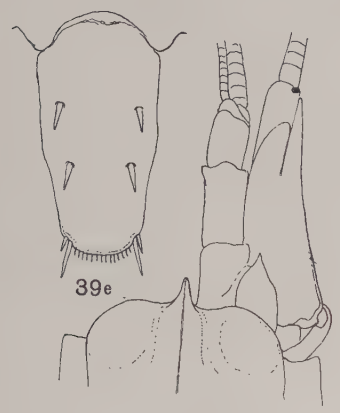

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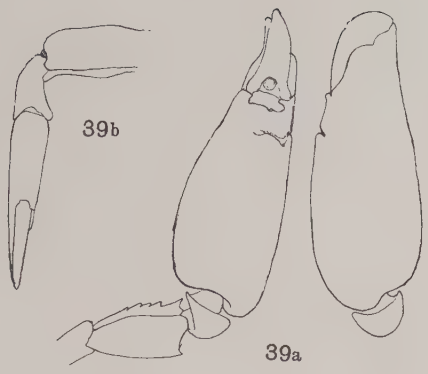

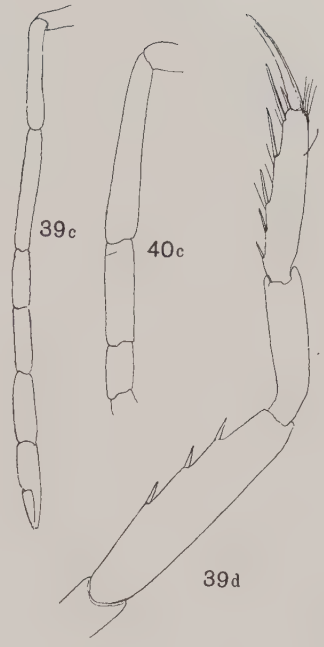

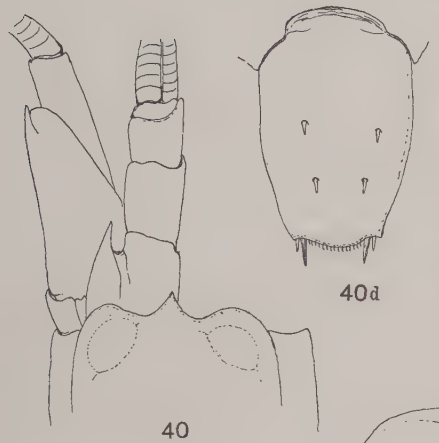

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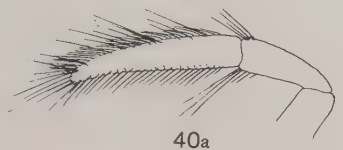
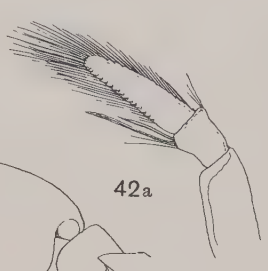
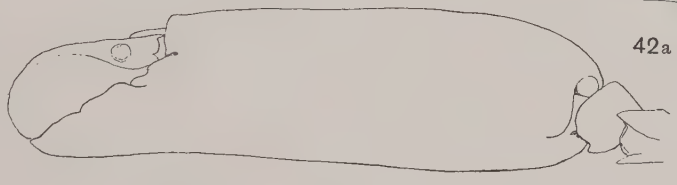
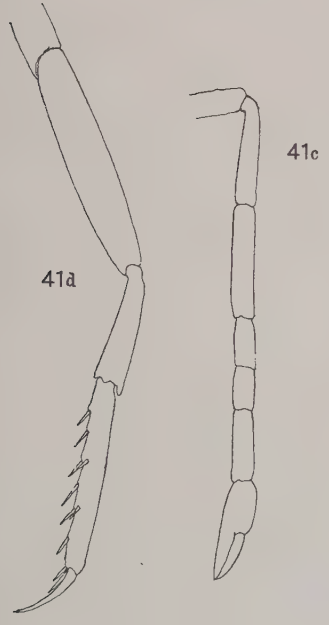
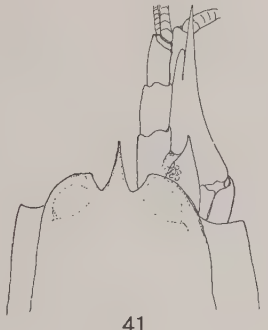
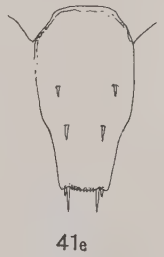


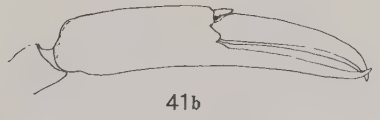


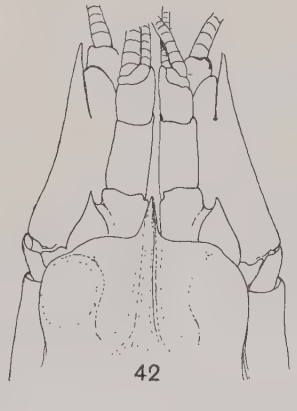






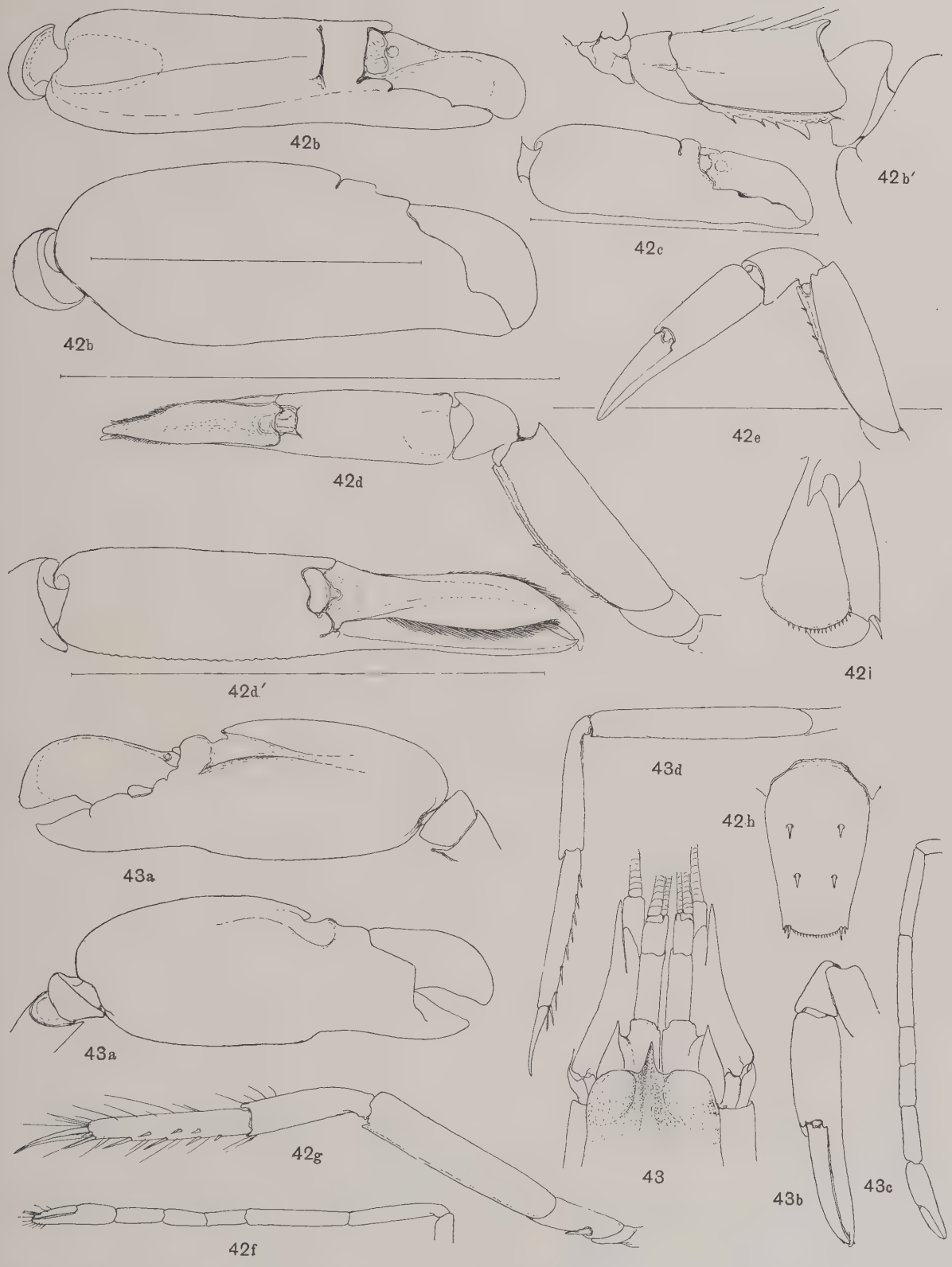






H. C. del.

COUTIÈRE——ALPHEIDAE.



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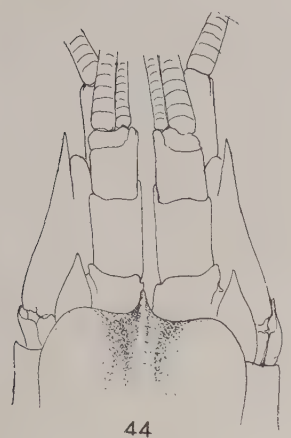
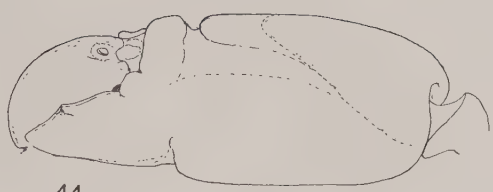


44

44b

44c



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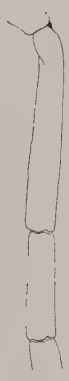

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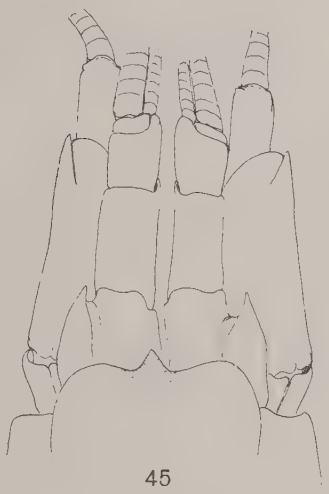

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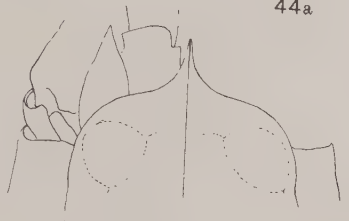

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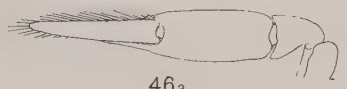
46b



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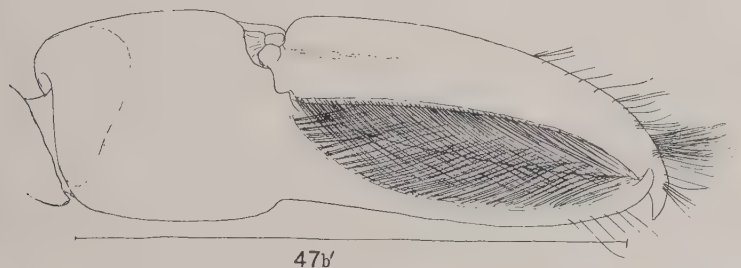
47b

47a



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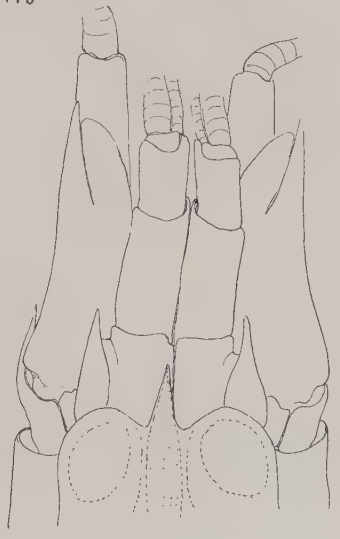

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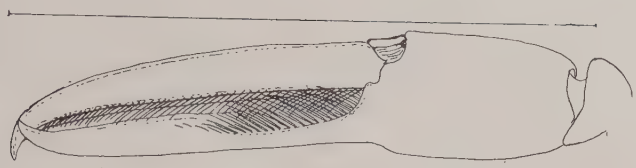
H. C. del.

COUTIÈRE——ALPHEIDAE.

47c



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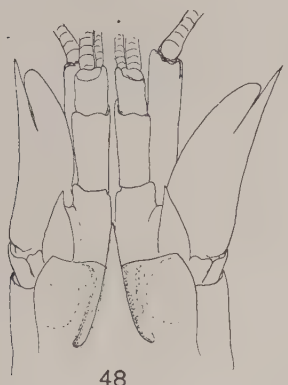

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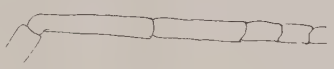

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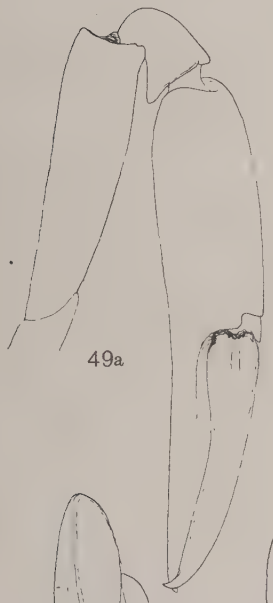

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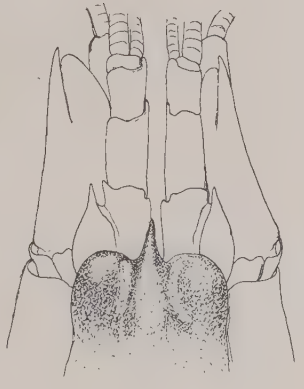


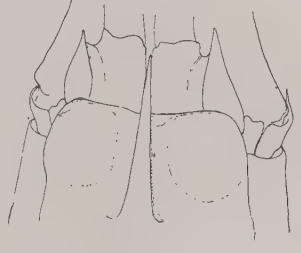
50

48b

50a″

50a

50a



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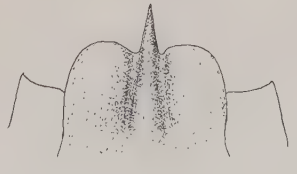

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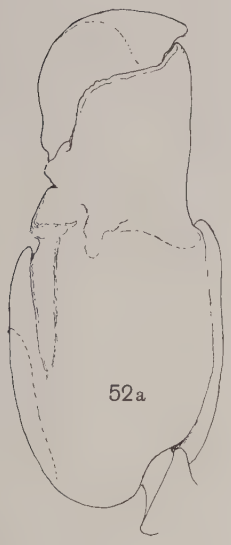
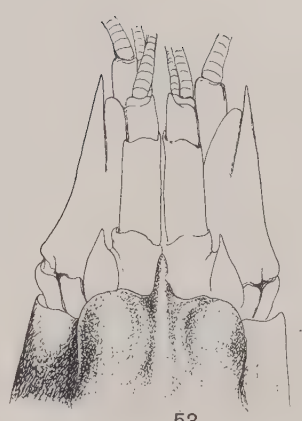
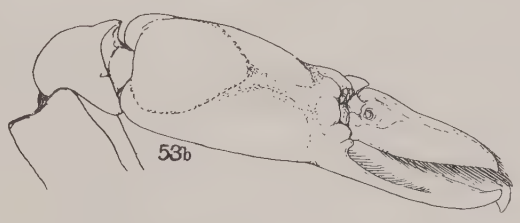
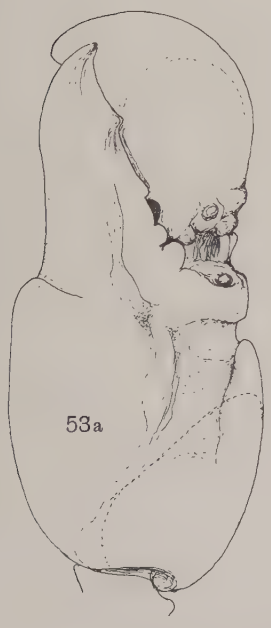
H. C. del.

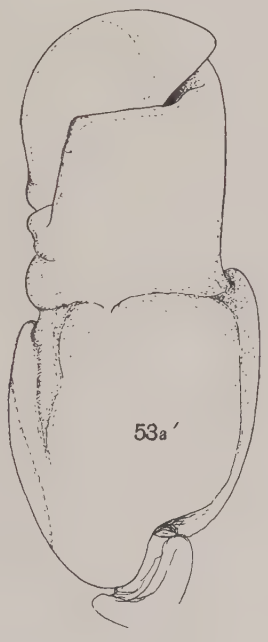
COUTIÈRE——ALPHEIDAE.

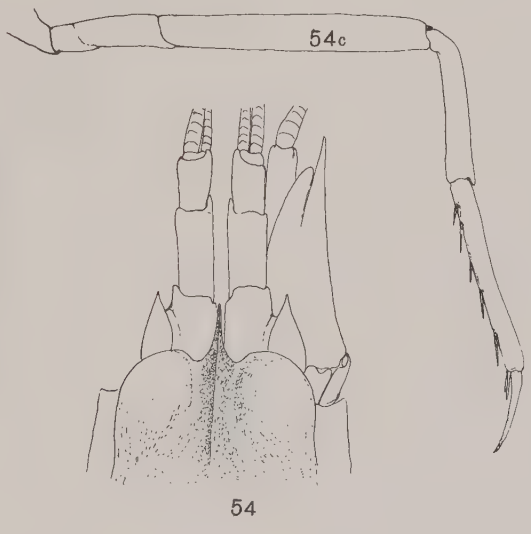


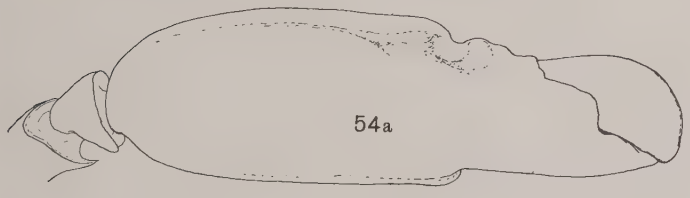


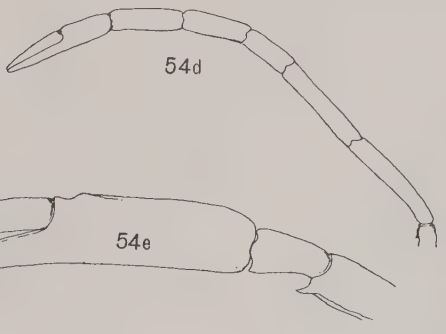


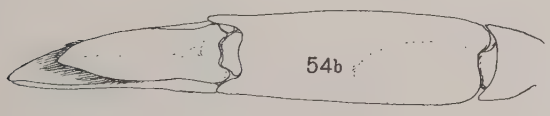












H. C. del.

COUTIÈRE—ALPHEIDAE.

PLATE LXXX.

Fig. 32 *c*. *Alpheus paraculeipes* (suite), petite pince de la 1re paire (♂), × 21 ; 32 *d*. petite pince de la 1re paire (♀), × 21 ; 32 *e*. 2me paire (carpe), × 30 ; 32 *f*. 3me paire, × 30 ; 32 *f'*. 3me paire (détails du méropodite), × 100 ; 32 *g*. 4me paire (détails du méropodite), × 30.

Fig. 33. *Alpheus spongiarum* H. C., sp. ♂ de Djibouti (type), patte de la 3me paire, × 30.

Fig. 34. *A. paralcyone* H. C., sp. ♂ (type), × 30 ; 34'. sp. ♂ vu latéralement, × 30 ; 34''. autre sp., bord frontal, × 30 ; 34 *a*. grande pince de la 1re paire (♂), × 12 ; 34 *a'*. grande pince (carpe et méropodite), × 12 ; 34 *b*. grande pince de la 1re paire (♀), × 12 ; 34 *c*. petite pince de la 1re paire (♂), × 12 ; 34 *d*. petite pince de la 1re paire (♀), × 12 ; 34 *e*. 2me paire (carpe), × 30.

PLATE LXXXI.

Fig. 34 *f*. *Alpheus paralcyone* (suite), 3me paire, × 30 ; 34 *g*. telson, × 30 ; 34 *h*. uropodes, × 30.

Fig. 35. *Alpheus superciliaris* H. C., sp. ♂ (type), × 30 ; 35 *a*. maxillipèdes III, × 21 ; 35 *b*. grande pince de la 1re paire, × 12 ; 35 *b'*. grande pince (carpe et méropodite), × 30 ; 35 *c*. petite pince de la 1re paire (♂), × 30 ; 35 *d*. 2me paire (carpe), × 30 ; 35 *e*. 3me paire, × 30 ; 35 *e'*. 4me paire (méropodite), × 30 ; 35 *f*. telson, × 30 ; 35 *g*. uropodes, × 30.

Fig. 36. *Alpheus clypeatus* H. C., sp. ♂ (type), × 30 ; 36'. sp. ♂ vu latéralement, × 30.

PLATE LXXXII.

Fig. 36 *a*. *Alpheus clypeatus* (suite), grande pince de la 1re paire (♂), × 30 ; 36 *b*. petite pince de la 1re paire (♂), × 30 ; 36 *c*. petite pince de la 1re paire (♀), × 30 ; 36 *d*. 2me paire, carpe, × 30 ; 36 *e*. 3me paire, × 30 ; 36 *e'*. 4me paire (méropodite), × 30 ; 36 *f*. telson ; 36 *g*. uropodes, × 30.

Fig. 37. *Alpheus paracrinitus Bengalensis* H. C., sp. ♀ (type), × 30 ; 37'. sp. ♀ vu latéralement, × 30 ; 37 *a*. grande pince de la 1re paire, × 21 ; 37 *a'*. grande pince de la 1re paire (carpe et méropodite), × 21 ; 37 *b*. petite pince de la 1re paire chez un autre sp. ♂, × 30 ; 37 *c*. 2me paire, carpe, × 30 ; 37 *d*. 3me paire, × 30 ; 37 *e*. telson, × 30 ; 37 *f*. uropodes, × 30.

Fig. 38. *Alpheus paracrinitus* Miers, petite pince de la 1re paire (sp. ♂ de Djibouti), × 30 ; 38 *a*. 2me paire, carpe, × 30.

PLATE LXXXIII.

Fig. 39. *Alpheus Lanceloti* H. C., sp. ♂ (type), × 30 ; 39 *a*. grande pince de la 1re paire, ses 2 faces, × 12 ; 39 *b*. petite pince de la 1re paire, ses 2 faces, × 12 ; 39 *c*. 2me paire (carpe), × 30 ; 39 *d*. 3me paire, × 30 ; 39 *e*. telson, × 30.

Fig. 40. *Alpheus alpheopsides* H. C., sp. ♂ (co-type), × 30 ; 40 *a*. maxillipèdes III, × 30 ; 40 *b*. petite pince, × 12 ; 40 *c*. 2me paire, × 30 ; 40 *d*. telson, × 30.

Fig. 41. *Alpheus paralpheopsides* H. C., sp. ♂ (type), × 30 ; 41 *a*. grande pince de la 1re paire, × 30 ; 41 *b*. petite pince de la 1re paire, × 30 ; 41 *c*. 2me paire (carpe), × 30 ; 41 *d*. 3me paire, × 30 ; 41 *e*. telson, × 30.

Fig. 42. *Alpheus Miersi* H. C., sp. ♂ (co-type), × 21 ; 42 *a*. maxillipèdes III, × 21.

PLATE LXXXIV.

Fig. 42 *b*. *Alpheus Miersi* H. C. (suite), grande pince de la 1re paire, face supéro-interne et bord supérieur (le trait indique la longueur comparée du céphalothorax, comme sur les autres figures), × 21 ; 42 *b'*. grande pince, carpe et méropodite, × 21 ; 42 *c*. grande pince de la 1re paire (♀), × 12 ; 42 *d*. petite pince d'un ♂, × 21 ; 42 *d'*. petite pince d'un autre ♂, × 21 ; 42 *e*. petite pince d'une ♀, × 21 ; 42 *f*. 2me paire, × 21 ; 42 *g*. 3me paire, × 21 ; 42 *h*. telson, × 21 ; 42 *i*. uropodes, × 21.

Fig. 43. *Alpheus pareuchirus* H. C., sp. ♂ (type), × 30 ; 43 *a*. grande pince de la 1re paire (faces interne et externe), × 30 ; 43 *b*. petite pince de la 1re paire, × 30 ; 43 *c*. 2me paire, × 30 ; 43 *d*. 3me paire, × 30.

PLATE LXXXV.

Fig. 44. *Alpheus Bouvieri* A. M.-E., sp. ♂ (co-type), × 30 ; 44 *a*. grande pince de la 1re paire (faces interne et externe), × 12 ; 44 *b*. petite pince de la 1re paire, × 12 ; 44 *c*. 2me paire (carpe), × 30.

Fig. 45. *A. Bastardi* H. C., sp. ♂ (co-type), × 30 ; 45 *a*. petite pince de la 1re paire, × 12 ; 45 *b*. 2me paire (carpe), × 30 ; 45 *c*. *A. Haani* Ortmann (*A. minor* de Haan), bord frontal, × 3 ; 45 *d*. grande pince, face supéro-interne, × 3, fac-similé de dessins du Dr. Horst, d'après le type de de Haan (musée de Leyde).

Fig. 46. *A. Bouvieri Hululensis* H. C., sp. ♂ (co-type), × 30 ; 46 *a*. petite pince de la 1re paire, × 12 ; 46 *b*. 2me paire (carpe), × 12.

Fig. 47. *Alpheus Pacificus* Dana, sp. ♂, × 30 ; 47 *a*. grande pince de la 1re paire, × 12 ; 47 *b*. petite pince de la 1re paire (♂), × 12 ; 47 *b'*. petite pince de la 1re paire (♂), autre spécimen, × 12 (le trait indique la dimension comparée du céphalothorax).

PLATE LXXXVI.

Fig. 47 *c*. *Alpheus Pacificus* Dana (suite), petite pince de la 1re paire (♀), × 12 ; 47 *c'*. petite pince de la 1re paire (♀), autre spécimen, × 12 (le trait indique la dimension comparée du céphalothorax) ; 47 *d*. 2me paire (carpe), × 21.

Fig. 48. *Alpheus bis-incisus Malensis* H. C., sp. ♂ (type), × 21 ; 48 *a*. grande pince de la 1re paire, × 12 ; 48 *b*. petite pince de la 1re paire, × 12 ; 48 *c*. 2me paire, carpe, × 21 ; 48 *d*. 3me paire, dactylopodite (vu latéralement et en dessus), × 30.

Fig. 49. *Alpheus bis-incisus stylirostris*, sp. ♂ (type), × 30 ; 49 *a*. petite pince de la 1re paire, × 30.

Fig. 50. *Alpheus Edwardsi* Audouin, sp. ♂ de Madras, répondant au type de Savigny, région céphalique, × 12 ; 50 *a*. grande pince de la 1re paire, face supéro-interne, × 4 ; 58 *a'*. grande pince, bord supéro-externe, × 4 ; 50 *a''*. grande pince, bord inféro-interne, × 4 ; 50 *b*. 2me paire (carpe), × 12.

Fig. 51. *Alpheus chiragricus* H. M.-Edwards, sp. ♂ (type), × 12.

PLATE LXXXVII.

FIG. 52 *a*. *Alpheus Audouini* H. C., grande pince de la 1re paire, face supéro-interne, × 4 ; 52 *a'*. grande pince de la 1re paire, bord supéro-externe, × 4 ; 52 *a''*. grande pince de la 1re paire, bord inféro-interne, × 4.

FIG. 53. *Alpheus strenuus* Dana, sp. ♂, × 6 ; 53 *a*. grande pince, face inféro-interne, × 3 ; 53 *a'*. grande pince, face supéro-externe, × 3 ; 53 *b*. petite pince, × 3.

FIG. 54. *Alpheus leptochirus* H. C., sp. ♂ (type), × 30 ; 54 *a*. grande pince de la 1re paire, × 30 ; 54 *b*. petite pince de la 1re paire (♂), × 30 ; 54 *c*. petite pince de la 1re paire (♀), × 30 ; 54 *d*. 2me paire (carpe), × 30 ; 54 *e*. 3me paire, × 30.

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MARINE CRUSTACEANS.

XVI. AMPHIPODA.

By Alfred O. Walker, F.L.S., F.Z.S.

(With Plate LXXXVIII. and Text-Figures 140—142.)

The collection of Amphipoda made by Mr Stanley Gardiner's Expedition to the Maldives shows, as might be expected, considerable affinity to the Amphipod fauna of Ceylon on the one side and the Seychelles Islands on the other. Perhaps the most interesting feature of it is the occurrence at a depth of 20 fathoms of *Orchestia platensis* Kr. This species is stated by Mr Stebbing to have occurred at an elevation of 3000 feet in Hawaii, some specimens from the same islands having been found in dead wood! Is there any other highly organized animal or even vegetable known to exist under such extraordinarily varied conditions?

Tribe Gammaridea.

	Previously recorded from
Fam. **Orchestiidae.**	
Orchestia platensis Kröyer.	River Plate; E. coast of N. America; W. Indies; Bermuda; Hawaii.
Hyale nilssoni (Rathke).	Atlantic and Mediterranean; Azores; Sokotra; Ceylon.
Fam. **Lysianassidae.**	
Lysianax cinghalensis Stebbing.	Ceylon; I. of Sokotra.
Fam. **Ampeliscidae.**	
Ampelisca tridens A. O. Walker.	Ceylon.
Fam. **Leucothoidae.**	
Leucothoë spinicarpa (Abild.).	Cosmopolitan.
L. hornelli A. O. Walker.	Ceylon.
Fam. **Atylidae.**	
Paratylus minikoi n. sp.	
Fam. **Dexaminidae.**	
Polycheria atolli n. sp.	

	Previously recorded from
Fam. **Gammaridae.**	
Maera scissimana (Costa).	Mediterranean; Ceylon.
M. rubromaculata (Stimpson).	Pacific; Australia; Cape Agulhas; Ceylon.
M. othonides A. O. Walker.	Ceylon.
Elasmopus rapax Costa.	Atlantic and Mediterranean coasts of Europe; Azores.
E. eurybrachion n. sp.	
Parelasmopus suluensis (Dana).	N. Australia; Sulu Sea; Ceylon.
Fam. **Aoridae.**	
Lembos podoceroides A. O. Walker.	Ceylon.
Fam. **Photidae.**	
Gammaropsis gardineri n. sp.	
Fam. **Amphithoidae.**	
Paragrubia vorax Chevreux.	Seychelles Islands.
Grubia microphthalama Chev.	Seychelles Islands.
Amphithoë intermedia A. O. Walker.	Ceylon.

Genus *Orchestia* Leach, 1814.

1. *O. platensis* Kröyer. Fig. 140. 2.

O. platensis Kr., Stebbing, *Fauna Hawaiiensis*, vol. II. p. 527, Pl. XXI. A.

Mahlosmadulu Atoll, 20 *f.*, eight specimens.

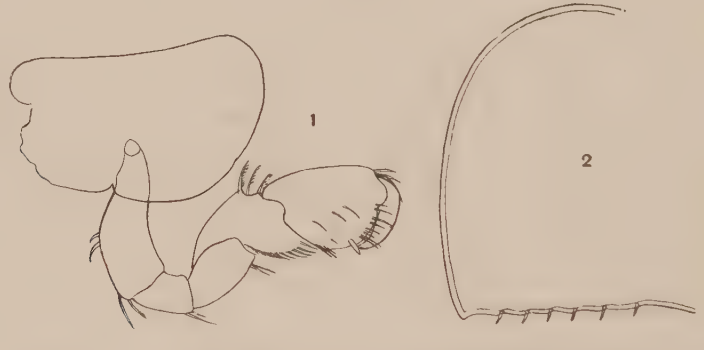

FIG. 140. 1. *Hyale nilssoni* Kröyer; 1st gnathopod, ♂. 2. *Orchestia platensis* (Rathke); hind margin of the 3rd pleon segment with spinules.

The lower antennae are shorter and more robust than in the Hawaiian specimens, the flagellum in the male being 11-jointed and in the female 10-jointed, but this is a character varying with age. The hind-margin of the third pleon segment is almost straight and obscurely toothed with about six spinules on the teeth (Fig. 140. 2). Length of male 8 mm., of female with ova 6 mm. The bathymetrical distribution of this species is truly extraordinary. Mr Perkins found it at an elevation of 3000 feet above sea level (Stebb. *l.c.*).

O. anomala Chevreux (4, p. 393, figs. 8—12) from the Seychelles appears to differ from this species only in the averted point of the dactylus of the second gnathopod in the male.

Genus *Hyale* Rathke, 1837.

2. *H. nilssoni* (Rathke). Fig. 140. 1.

Lagoon Minikoi, several.

The first gnathopod in the male is rather larger than in the European forms of this species; the wrist is as long as the hand and rounded behind; the front margin subequal to that of the hand; this is more than half as wide as long, the palm forming a continuous curve with the hind margin (Fig. 140. 1). In the female this limb closely resembles the European form. The second gnathopod in the male is very near the European form, but the palm is almost straight, very spinous and defined only by a spine. In the female the wrist is rather less produced behind, otherwise it is like the type. In other respects the specimens agree generally with the type but show a considerable amount of variation *inter se.*

Length of male 8 mm.; female with ova 6·5 mm.

Genus *Lysianax* Stebbing, 1888.

3. *L. cinghalensis* Stebbing (14, p. 28, Pl. 7 A).

Hulule, Male Atoll, two females. N. Male Atoll, 35 *f.*, eight specimens. Length of female, 7 mm. This is the same form with the squarely truncate telson as that taken on the Ceylon coasts by Dr Herdman.

Genus *Ampelisca* Kröyer, 1842.

4. *A. tridens* A. O. Walker (15, p. 249, Pls. II. and IV. fig. 11).

Mahlosmadulu Atoll, 20 *f.*, one specimen; length 6 mm. Miladumadulu Atoll, one young.

Genus *Leucothoë* Leach, 1814.

5. *L. spinicarpa* (Abildgaard).

Hulule, Male Atoll, one specimen; length 9 mm.

6. *L. hornelli* A. O. Walker (15, p. 258, Pl. III. fig. 17).

Minikoi, 7—9 *f.*, four specimens; length 5 mm.

Genus *Paratylus* G. O. Sars, 1895.

7. *P. minikoi* n. sp. Fig. 141. 1—5.

Lagoon, Minikoi, one specimen.

Head about as long as the first two segments, with a small rostrum. Segments of the mesosome and pleon without postero-dorsal teeth. Epimere of the third pleon segment with the hind margin, convex and hollowed out above the slightly upturned posterior angle (141. 1). First segment of the urus with a transverse dorsal depression about the middle followed by an elevated and pointed carina (141. 2); the anterior tooth on this segment, as in *P. swammerdamii* (M.-Edw. and Sars, 11, p. 463, Pl. CLXIII.), is wanting. Second and third segments

of the urus are coalesced with a similar but smaller carina. Branchial appendages conspicuous, obliquely pinnate.

The upper antennae reach to the end of the fifth joint of the flagellum of the lower which reach to the fourth mesosome segment; the proportions of the joints as in *P. swammerdamii*. Mouth organs and maxillipeds normal. First gnathopods: side-plates oblong, more than twice as deep as wide with setules on the lower margin. First joint longer than the next three, with divergent setae on the hind margin; wrist shorter than the hand, widening distally, sparsely setose on the front margin and with three fascicles of setae on the hind; hand oval, palm continuous with the hind margin and defined by a spine about the middle; the front margin with four setiferous ridges. Dactylus about half as long as the hind margin. Second gnathopod like the first but rather larger (141. 3). First and second peraeopods as in *P. swammerdamii*. Third peraeopods much shorter than the fourth and fifth; side-plates wider than deep; first joint narrowing distally, the hind margin not produced; remaining joints as in *P. swammerdamii* (141. 4). Fourth and fifth peraeopods subequal, the latter extending to the end of the uropods; their structure is similar to that of the third pair.

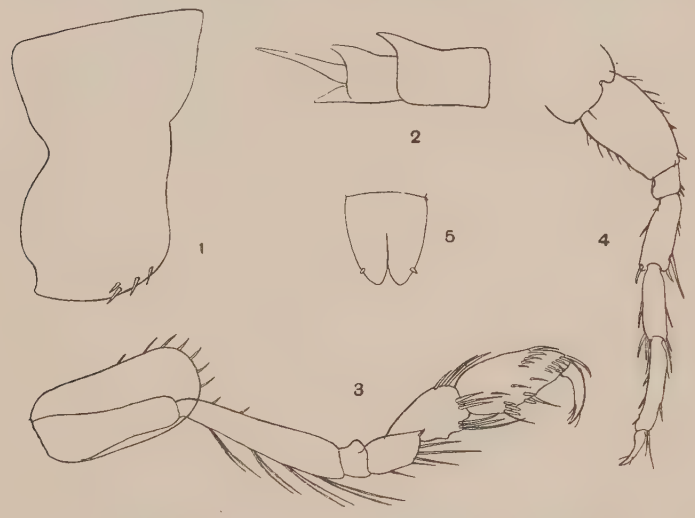

Fig. 141. *Paratylus minikoi* n. sp. 1. epimere of the 3rd pleon segment. 2. urus. 3. 2nd gnathopod. 4. 3rd peraeopod. 5. telson.

Uropods as in *P. swammerdamii*, but the longer ramus of the second pair extends almost as far as the first and third. Telson reaching nearly to the middle of the rami of the third uropods, cleft almost to the base with a submarginal spine near the bluntly pointed end of each division (141. 5).

Length 5 mm. This species may be distinguished by the structure of the urus and the first joints of the last three pairs of peraeopods.

Genus *Polycheria* Haswell, 1880[1] (9, vol. iv. p. 345).
Dexamine Stebbing, *Ann. and Mag. Nat. Hist.* 1875.
Tritaeta Stebbing, 1888 (13, p. 941).

8. *P. atolli* n. sp. Pl. LXXXVIII. figs. 1—5.

Hulule, Male Atoll, six specimens.

General appearance of *P.* (*Tritaeta*) *Kergueleni* (Steb.). Third pleon segment with the posterior angle slightly produced, acute. First and third segments of urus with dorsal teeth.

[1] See 15, p. 266.

Antennae as in *P. Kergueleni*. First maxillae: palp longer and narrower than the outer plate, *the top squarely truncate and crowned with short teeth* (fig. 1). Maxillipeds as in *P. Kergueleni* except the outer plate which has alternate teeth and short spines on the distal third of the inner margin only (fig. 2). First gnathopods: side-plates very small, produced forwards with the angle rounded and a setule at the apex (fig. 3). First joint narrow, widening distally, as long as the next four; third, fourth and fifth subequal in length and width, their hind margins very setose; hand oval, the palm undefined. Dactylus strong, spinulose near the point. Second gnathopods longer and more slender than the first; side-plates larger, subquadrate with rounded angles (fig. 4). First joint as long as the next four; wrist half as long again and about as wide as the hand which is narrow-oval, the palm scarcely defined. Dactylus as in the first pair. First and second peraeopods are longer than the gnathopods and resemble those of *P. Kergueleni* except in being more slender and the end of the fifth joint less excavated (fig. 5): the side-plates in the first pair are subtriangular, the anterior angle rounded. Remaining peraeopods like the first and second.

First and third uropods subequal in extent, the second much shorter; the third pair without spines. Telson reaching almost to the middle of the rami of the third uropods, cleft to the base with a submarginal spine near the point of each division. This species is nearly allied to *P. tenuipes*, Haswell, from which it differs in having a dactylus or nail on the palp of the maxillipeds and in the form of the hand of the second gnathopods. From *P. Kergueleni* it differs in the shape of the palp of the first maxillae, in the armature of the outer plates of the maxillipeds and the absence of spines on the third uropods and telson (except the two mentioned). The side-plates are also somewhat different. *P.* (*Dexamine*) *antarctica* (Stebbing) is not very fully described but apparently differs in the form of the wrist and hand of the second gnathopods.

I have thought it desirable to revive Haswell's genus *Polycheria* on account of the difference in the structure of the grasping apparatus in this and *Tritaeta*. In the former the end of the fifth joint and in the latter the end of the fourth are modified to meet the point of the dactylus to form such apparatus. The genus should be defined "as *Tritaeta* Boeck, except as to the peraeopods, in which the end of the propodal joint is modified to form a grasping organ with the dactylus."

Genus *Maera* Leach, 1813.

9. *M. othonides* A. O. Walker (15, p. 271, Pl. v. fig. 29).

Mahlosmadulu Atoll, 20 *f.*, one male.

10. *M. scissimana* (Costa, 5, p. 221, Pl. III. fig. 7).

Boulder zone, Hulule, 6; Mahlosmadulu Atoll; Minikoi, shoal in lagoon 7. Length of female with ova 5 mm.

The last three pairs of peraeopods in these specimens are less robust and more like the Mediterranean than the Ceylon forms.

11. *M. rubromaculata* (Stimpson).

Ceradocus rubromaculatus Della Valle (8, p. 720).

N. Male Atoll, 30 *f.*, one male; Mahlosmadulu Atoll, 20 *f.*, 2 and 23 *f.*, 3. Length of largest 9 mm.

In the male from N. Male the palm of the second gnathopods is transverse as in *M. scissimana*, but this is a very variable feature in this species.

Genus *Elasmopus* Costa, 1856.

12. *E. rapax* Costa (5, p. 212, Pl. IV. fig. 5).

Hulule, one male, one female.

13. *E. latibrachium*[1] n. sp. Pl. LXXXVIII. figs. 6—10.

Hulule, 11; Minikoi, 7—9 *f.*, 1.

Head as in *E. rapax*. Eye oval, dark. Mesosome and pleon without dorsal teeth or spines; hind margin of the epimere of the third pleon segment rather convex above and concave below, the angle somewhat produced, acute. First segment of urus with two parallel carinae produced behind in up-turned points (fig. 6).

Upper antennae: first joint as long and nearly three times as wide as the second with a distal spine on the lower margin; third joint about one-third as long as the second; flagellum subequal to the peduncle, nine-jointed; appendage two-jointed, rather longer than the first joint of the flagellum (fig. 7). Lower antennae as in *E. rapax*. Mandibular palp shorter than the length of the upper margin from the base of the palp to the cutting edge; naked with the exception of two terminal setae; *the first joint scarcely shorter than the second, the two united subequal to the third* (fig. 8). Inner plate of the first maxillae oval at the top with two plumose setae and a setule.

Maxillipeds as in *E. subcarinatus* (Has.) (9, vol. IV. p. 335, Pl. XXI.) = *E. persetosus* Stebb. (13, p. 1019, Pl. XCVIII.). First gnathopods: side-plates deeper than wide, sub-oblong, with a tooth at the hinder angle; anterior angle rounded, the front margin rounded. The limb as in *E. rapax*.

Second gnathopods. Male (fig. 9). Side-plates with the front margin straight, otherwise as in the first gnathopods. *First joint remarkably wide, subequal to the hand in length and width;* second deeply sunk in the end of the first; wrist small, subtriangular, with a short, densely setose posterior lobe. Hand oval, widest about the middle, palm undefined; *the posterior surface of the distal two-thirds covered with small tubercles increasing in size distally;* three or four scanty fascicles of setae on the proximal one-third and a few setules among the tubercles. Dactylus less than half as long as the hind margin. The whole limb is without setae or spines except where the former are mentioned.

In the female the first joint is as long as the hand and wrist united, narrow, slightly curved with about seven long setae in a row near the middle of the outer surface; in other respects the limb resembles that of the female *Elasmopus rapax*.

The first and second peraeopods resemble those of *E. rapax* but are less hairy, and the same may be said of the remaining three pairs except the hind margin of the first joint of the third and fourth pairs which is slightly concave.

[1] From the great width of the first joint of the second gnathopods in the male.

The rami of the third uropods are subequal and similar, and longer than the peduncle; the outer has three fascicles of spines on the outer margin; the inner has two on the inner.

The telson reaches beyond the end of the peduncles of the third uropods and is cleft to the base; each division is deeply notched with the outer angle acutely produced, and three unequal spines in the notch (fig. 10).

Length 5 mm. The general aspect of this species resembles that of *E.* (*Megamocra*) *subcarinata* (Haswell) from which it differs in the mandibular palp and the structure and nakedness of the second gnathopods in the male, by the powerful first joint of which it is most easily distinguished.

Genus *Parelasmopus* Stebbing, 1888.

14. *P. suluensis* (Dana).

Gammarus suluensis Dana (7, p. 947, Pl. LXV. fig. 3). *Megamaera suluensis* sp. Bate (1, p. 230, Pl. XL. fig. 6).

Mahlosmadulu Atoll, 20 *f.*, 5; Miladumadulu, 20 *f.*, 2; Minikoi, 5—9 *f.*, 4. Length of female 7 mm.

In the sculpture of the palm of the second gnathopod in the male the specimens resemble the Ceylon form rather than the "Challenger." The inner plate of the first maxillae has only *one* plumose setule.

Genus *Lembos* Sp. Bate, 1857 (2, 3). Stebbing (12, p. 206).

15. *L. podoceroides* A. O. Walker (15, p. 279, Pl. VI. fig. 39).

Mahlosmadulu Atoll, 23 *f.*, one female; length 5 mm.

Genus *Gammaropsis* Lilljeborg, 1854.

16. *G. Gardineri* n. sp. Pl. LXXXVIII. figs. 11—14, 16, 17.

Hulule, 4; Fadifolu, 15 *f.*, 7 and 23 *f.*, 1; Mahlosmadulu Atoll, 23 *f.*, 1; Minikoi, 7—9 *f.*, 1.

Body smooth. Epimere of the third pleon segment rounded behind with a small notch and setule in place of the posterior angle; lower margin slightly convex.

Ocular lobe much produced, reaching to the end of the first joint of the lower antennae, the extremity ovate; eye, which is probably red, filling the distal half of the lobe (fig. 11). Upper antennae about two-thirds of the length of the body, first and third joints subequal, second nearly twice as long. Flagellum 14-jointed, hardly as long as the peduncle. Appendage 4—5-jointed, variable. Lower antennae in the female reaching rather beyond the middle of the flagellum of the upper; first joint about half as long as the second which is subequal to the third; flagellum shorter than the second and third united. Both pairs of antennae are furnished with rather distant fascicles of two long and one or two short setae. Mandibles

as in *G. erythrophthalmus* Lillje. First maxillae: inner plate ob-pyriform, a minute setule on the pointed apex and 10—11 longer on the outer margin (fig. 12). Maxillipeds normal.

First gnathopods (fig. 13): side-plates rhomboidal, angles rounded. First joint slightly curved, widening distally and rather longer than the wrist which is subequal to, and rather narrower than the hand; this is oval with the palm undefined. Dactylus more than half as long as the hind margin, serrate. Second gnathopods. Male. Side-plates sub-oblong, angles rounded. First joint stout, rather more than half as long as the hand; wrist short, triangular, hind margin slightly produced, setose; hand oval, palm shorter than the rest of the hind margin, very oblique, tuberculate, and defined by a blunt tooth with a notch below to receive the point of the dactylus, and a spine above. In young males the palm is excavated above and below the convex centre which stands out as a flattened tubercular prominence (fig. 14). The females (fig. 16) have the limb smaller; the hand has the palm twice as long as the rest of the hind margin and divided in two equal parts by an obtuse angle and a strong spine; the proximal half concave with a fascicle of unequal setae in the middle; the distal convex and spinous. The dactylus reaches to the fascicle of setae in the concave half. The peraeopods resemble those of *G. erythrophthalmus* except the first joints of the first and second pairs which are stronger, and the hind margins of the first joints in the fourth and fifth pairs which are almost straight. The uropods are subequal in extent, the first and second very spinous; the third pair has the outer ramus subequal to the peduncle and longer and wider than the inner.

The telson has a small setiferous tubercle and blunt spine at the posterior angles; the lower part seen from above when mounted, projects in a point beyond the upper (fig. 17).

The second gnathopods in both sexes distinguish the species.

Genus *Paragrubia* Chevreux, 1901 (4, p. 426, figs. 50—55).

17. *P. vorax* Chev., 4, Pl. LXXXVIII. fig. 18.

Hulule, 1; Minikoi, three specimens. Length of largest 9 mm.

The telson in this and the next species appears to be a hollow truncated cone, the upper side of which is deeply notched or split (fig. 18); each edge of the notch is furnished with a row of upright setae. When compressed under the cover of the microscope slide and seen from above it has the appearance figured by Chevreux.

Genus *Grubia* Czerniawsky, 1868 (6, p. 103).

18. *G. microphthalma* Chev. (4, p. 422, figs. 46—49), Pl. LXXXVIII. fig. 15. Fig. 142.

Boulder Zone, Hulule, 3; Minikoi, 3. Length of female with ova, 10 mm.

Mons. Chevreux having only seen the female of this species, I will give the features in which the male differs. First gnathopods (fig. 142): the palm is well defined, concave, shorter than the rest of the hind margin and rather sparsely setose; the whole limb is granulose. Second gnathopods: side-plates oblong, rounded below (fig. 15). First joint nearly as long as the hand, stout, with a distal expansion on the front margin; third joint oblong; wrist short, subtriangular, produced behind in a short, setose spur. Hand almost as wide as long, forming

with the closed dactylus a regular ellipse; palm oblique, defined by a strong tooth, with a flat-topped granular prominence in the middle; dactylus strong, the point touching that of the palmar tooth; a few scattered setae on the hind margin and at the base of the dactylus.

Notwithstanding the differences in the appendage of the upper antennae &c. in *Paragrubia vorax* and *Grubia microphthalma*, I should not be surprised if the former were to prove to be the immature condition of the latter, from the many points of resemblance and their occurrence together.

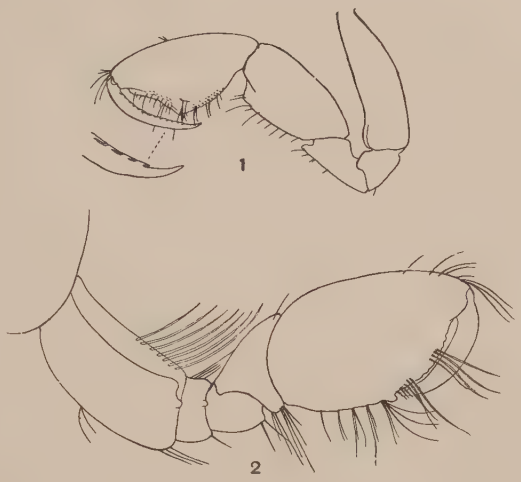

Fig. 142. *Grubia microphthalma* Chev. 1. 1st gnathopod, ♂. 2. 2nd gnathopod, ♂.

Genus *Amphithoë* Leach, 1813.

19. *A. intermedia* A. O. Walker (15, p. 290, Pl. VII. fig. 46).

Hulule, Male Atoll, 4. Length of female with ova, 6 mm.

In addition to the above there are two imperfect specimens without antennae &c. from Minikoi 7—9 *f.* They appear to be allied to *Dryopoides* Stebbing, but the rami of the third uropods are rather longer than the peduncles.

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DESCRIPTION OF PLATE LXXXVIII.

FIG. 1. *Polycheria atolli* n. sp. 1st maxilla.
FIG. 2. „ „ „ Maxilliped.
FIG. 3. „ „ „ 1st gnathopod.
FIG. 4. „ „ „ 2nd „
FIG. 5. „ „ „ 1st peraeopod.
FIG. 6. *Elasmopus latibrachium* n. sp. Urus.
FIG. 7. „ „ „ Head.
FIG. 8. „ „ „ Mandible.
FIG. 9. „ „ „ 2nd gnathopod ♂.
FIG. 10. „ „ „ Telson and 3rd uropods.
FIG. 11. *Gammaropsis Gardineri* n. sp. Head.
FIG. 12. „ „ „ 1st maxilla.
FIG. 13. „ „ „ 1st gnathopod.
FIG. 14. „ „ „ 2nd „ young male.
FIG. 15. *Grubia microphthalma* Chev. 2nd gnathopod ♂.
FIG. 16. *Gammaropsis Gardineri* n. sp. 2nd „ female.
FIG. 17. „ „ „ Telson and third uropods.
FIG. 18. *Paragrubia vorax* Chev. Telson.

E. W. del.

WALKER——AMPHIPODA.

MADREPORARIA.

PARTS III. AND IV.

By J. Stanley Gardiner, M.A., *Fellow of Gonville and Caius College, and Demonstrator in Animal Morphology in the University of Cambridge.*

(With Plates LXXXIX—XCIII and Text-Figure 143.)

III. FUNGIDA.

The collection consists of 548 specimens, which I have been enabled to refer to their species, as well as a number of young forms and fragments. Of these 352 belong to solitary genera, but Fungia itself is a by no means unimportant reef-builder and we many times dredged rubble from 30 to 50 *f.* composed mainly of Cycloseris and Diaseris. Twenty-seven species (3 Fungia) and two varieties belonging to 15 genera are represented as compared with the 24 species (9 Fungia) of 9 genera mentioned by Klunzinger from the Red Sea and the 15 species of 7 genera, which I obtained in the Pacific. I have not attempted to go into the classification of the group, but Psammoseris I regard as a genus by itself, and Agaricia I place in the same family as Siderastrea. The Eupsammidae should perhaps be placed in the Fungida, but I prefer to treat them as a separate family.

Genus *Psammoseris.*

Psammoseris et Stephanoseris Ed. and H., *Pol. foss. des terr. pal.* p. 127, 1851, and Duncan, *Jour. Linn. Soc.* XVIII. pp. 152 *et seq.*, 1883.

I unite these two genera, since my series of specimens show intermediate forms in all the characters, which are supposed to separate them. The relationship of the genus with the Fungidae is of the slightest, synapticula being few in most coralla, and in some non-existent or at least not perceptible from surface view. It has, however, been correctly placed so far as the present rather unscientific scheme of classifying the Madreporaria goes. It represents either a case of parallel evolution in the Fungidae to the Turbinolidae or is an independent evolution from *Heterocyathus* with no real relationship to the Fungidae. The latter, as the genus is quite separate from all others in the Fungidae, appears to me to be the more probable, but I hesitate to adopt the course of placing it with the Turbinolidae without a more thorough review of the Fungidae than I have the materials to undertake. The genus consists at present only of the species recorded below.

1. Psammoseris rousseaui Ed. and H. (Pl. XCIII., fig. 27.)

Ed. and H., III. p. 57. P. hemispherica Ed. and H., III. p. 56.

The coralla vary enormously with age and environment in a similar manner to that described in the type-form of Heterocyathus aequicostatus (*Marine Investigations in S. Africa*, Vol. III. pp. 104—112, 1904). The *sipunculid tube* has in addition to its main opening 5—15 (generally about 10) other communications with the exterior on the side of the corallum between the costae but not arranged in any definite order; further there are often 1 or 2 small openings in the base, similar to those which form a common feature in H. aequicostatus. The *costae* are well developed, rounded and subequal, and generally bend over on to the base. The *septa* regularly form four cycles, but in the largest coralla some pairs of cycle V. are commonly present. All are quite regular, and decrease in breadth (from the side of the calice to their inner edges towards the axial fossa), in thickness and in exsertness in a regular order: I., II., IV. on either side of I., IV. on either side of II., and III. Often the septa of IV. on either side of those of I. are broader than those of II., and those of III. and the rest of IV. are set at such an angle that they fuse with them, and the fused series often joins its fellow at the edge of the axial fossa in front of the septa of cycle II. In the largest coralla the septa of cycle I. are 2—3 mm. exsert; the edges and sides of all are rough and spiny. All the septa slope gradually towards the axial fossa, but only those of cycle I. and the fused mass between the same reach it. In some of the larger coralla and in nearly all the smaller they merge gradually into it, but in others the edges are greatly broken up so that almost each septum appears to have one or more rough flattened *pali* or paliform lobes. The *columella* is formed of very fine trabeculae from the septal edges, in some coralla appearing from surface view quite spongy and in others finely papillary.

The calices vary in diameter from 7 to 14 mm. and in height from 3·5 to 7 mm.; they are round or slightly oval. No coralla show any external traces of the shells on which their polyps in the first place had settled, and in none does the base, save where the mouth of the sipunculid tube opens, project outside the area covered by its calice.

Locality. Haddumati Atoll, 37 fathoms, 46 specimens.

Genus *Siderastrea*.

The number of specimens in the collection (18 and some fragments) is not sufficient to properly determine the limits of variation in the genus, nor in any of its species. The identification of the species below may hence be a little doubtful, and the account of their variation is naturally quite incomplete. I have not generally regarded mode of growth alone as a specific character in corals, and below it is worthless. As compared with the original types, my specimens of S. clava are round masses instead of columns, of S. lilacea upstanding growths instead of flat incrustations, and of S. sphaeroidalis flat, incrusting, instead of rounded, free masses, while S. maldivensis has a spreading base, but may be massive in the centre, or rise up into columns. S. clava, lilacea and maldivensis disagree with the American species S. siderea and radians[1] as also with S. sphaeroidalis in having in their surface-parts the thecae of neighbouring calices quite separate from one another, joined together only by costae, instead of fused together into a single dividing wall. The costae, where they join one another,

[1] *U.S. Fish Commission Bull.*, 1900, vol. II. Pls. XIV.—XVI.

are often connected by vertical partitions at right angles, the whole appearing like a third wall,—like an epitheca between the two thecae, but really quite distinct and formed by fused synapticular rods.

The variation in S. maldivensis below is obviously vegetative, and, so far as my experience goes, more extraordinary and of a greater extent than has as yet been found in any other single species of the Madreporaria. Indeed, were it not for the internal structure different parts even of a single specimen might be selected which would quite reasonably have formerly been placed in three different genera.

2. Siderastrea clava (Dana). Pavonia clavus, Dana, p. 332, XXIV. 4; Siderastraea clavus, Gardiner, *Proc. Zool. Soc.* 1898, p. 525, XLIV. 1.

I refer five specimens to this species with some hesitation owing to the fact that they are all massive and incrusting. Though rising into low knolls, they present no columns such as Dana found and such as occur in my two Rotuman specimens, referred to above. There is, however, no real branching even in the latter specimens, and the character appears to me to be one which is purely vegetative. Nowhere do the calices on the upper surfaces of the Maldivan specimens present the coarse appearance described and figured in my larger Rotuman colony, but rather approximate to the apical calices of either of those two specimens, while most of their side calices are intermediate towards those of the figured Rotuman form.

In the specimens of the present collection the typical calices of the upper surfaces have generally 16—20 septa, alternately larger and smaller, the larger thicker and rougher near the thecae and commonly extending in to meet the thin, plate-like columella. In the same position the thecae of neighbouring calices are generally distinctly separated from one another (up to 5 mm.), though they may fuse in places. Over them the septa continue into costae, joined at right angles by rods or plates, often a central line, and are continuous between the polyp centres. At the sides and towards the lower parts of the specimens the gradual fusion up of the neighbouring thecae is visible to form single, solid walls; the septa also become thicker, more granulated and numerous. Increase is generally by intercalicular budding; fission is exceptional but often occurs on the lower surfaces.

Locality. Hulule, three specimens, largest 15 by 10 by 8 cm. thick, part of a rounded mass, all from the reef-flat; Goidu, a mass from the reef-flat; and Suvadiva, 20 *f.*, part of a mass with all its calices relatively coarse, approaching the figured Rotuman form.

3. Siderastrea lilacea Klz. Klz., p. 77, IX. 6 and X. 16 *a* and *b*.

A single, rounded, upstanding mass, 8 cm. high, top 8 by 6·5 cm., hollowed out in the centre, stalk 4·5 cm. thick, covered nearly all over with calices. Its specific characters appear to be (1) septa 26—36, about a third meeting in the axial fossa, (2) calices circular, 3 mm. broad, relatively deep with rounded walls, (3) thecae of neighbouring calices separated from one another at the surface of the corallum and similar to S. clava, (4) columella the trabecular junctions of the septa, low, sometimes rising into flat plates or short rods. The species is like an enlarged edition of S. clava with more septa, and shows parallel variations in different parts of its corallum.

Locality. Hulule, W. reef.

4. Siderastrea maldivensis n. sp. (Pl. LXXXIX. figs. 1—3.)

Corallum forming masses thin and spreading at the base, rising in the centre into knobs, or rounded or flattened columns. *Calices* divisible into three classes, agreeing to a large extent with the position they occupy on the colony:

(*a*) those on the ends of the columns and hence generally nearest the surface of the sea and the light, less than 2 mm. broad, rounded or oval, with distinct thecae (less than ·5 mm. apart), rather flat edges, and hence joined by costae, 16—20 septa, about half reaching a columella ending above in a single, round, twisted rod;

(*b*) those on the sides of the columns, 2—3 mm. broad, circular, rounded edges, fused theca, 18—22 septa, 8—9 reaching a columella either flat above or styliform;

(*c*) those on the spreading base, rather larger up to 4·5 mm. broad, quite circular, edges distinctly raised into rounded pads, 1—4 mm. distant from one another, joined by costae often fusing between the calices and simulating branching, in the smaller calices 20—24 septa but in the larger 28—36, generally no visible junctions with the columella which ends above in a single, thick, upstanding rod.

Septa everywhere ending nearly perpendicularly against the axial fossae, smooth-edged (untoothed), sides very spiny.

Every intermediate stage may be found between the three kinds of calices, the characters of which are given above. The septa themselves even in the larger calices scarcely vary, their apparent increase in thickness being due to their more echinulated sides, the real septa often showing in surface view as fine, white lines in their centres with rough, more transparent edges. The branching of the costae resembles that found in some Leptoseris (vide L. incrustans below), while the general arrangement of the calices on the sides of the columns recalls Pavonia explanulata (Ed. and H., D. 11, fig. 2, and Klz., IX. 8), but the ends of the knobs and columns and the sections of the coralla have the structure typical of Siderastrea.

Locality. Minikoi, one column from the lagoon with columns in the centre and a spreading base, growing together with a colony of Madrepora; Hulule, six specimens, incrusting only from the reef-flat, but incrusting with columns and knobs from the lagoon reef, largest a mass of columns, 8 cm. high, tops flattened up to 12 cm. long by 2—4 cm. broad, base thin, spreading out for 6—8 cm.; and Turadu, a columnar colony, and the incrusting, leaf-like edge, 16 by 13 cm., of a second, very large mass. Colour light green.

5. Siderastrea sphaeroidalis Ortmann. (Pl. LXXXIX. fig. 4.) *Zool. Jahrb., Syst.*, p. 496, T. XI. fig. 1.

I refer two pieces broken out of large, flat, incrusting masses to this species. Its chief specific characters seem to be (1) septa, about 24, alternately larger and smaller, (2) almost flat calices, 2—3 mm. broad, regularly polygonal, (3) thecae of neighbouring calices not distinct, generally only a single, vertical wall separating them in any part of the corallum, and (4) columella formed of trabeculae from the septal ends rising into one or two papillae. The differences between the calices of the centre and sides of the colonies are very similar to those in S. clava. The species should be compared with undoubted specimens of S. savignyana from the Red Sea, of which it seems to be a small edition; so far, however, as the descriptions go, it must at present be regarded as distinct.

Locality. Two specimens, from the reef-flat of Goidu, and from a shoal in the middle of Minikoi lagoon.

Genus *Agaricia*.

Quelch, *Challenger Report*, p. 116.

I feel very doubtful about referring the 14 specimens, with which I am now dealing, to the above genus, with which Mycedium is included. In the first place, so far as I can

see, the specimens are all Plesiofungidae, having endothecal dissepiments, and in the second their dominant form of growth is massive. Further, the synapticula are ill-developed and, save that they give rise to the walls, apparently unimportant. On the other hand, more or less well-defined dissepiments occur even in some of the foliose Agaricia, and in A. regularis Quelch, a massive form, are of considerable importance. In the latter too synapticula are only distinct near the margin. Lastly, form of growth, considering the diversity found in Montipora and Porites, or better in the more closely allied Psammocora and Pavonia, scarcely in this case seems a character on which generic distinction can be based. The presence of a distinct wall and the appearance of the calices recalls Psammocora (Plesioseris) australiae Rous., but this genus has no dissepiments. The presence of the latter suggests a relationship to Anomastraea[1]; but the synapticula of that genus are of great importance.

6. Agaricia ponderosa n. sp. (Pl. LXXXIX. figs. 5 and 6.)

Coralla forming large, more or less rounded masses, thin at the edges, but in the centres often several inches thick. *Bases* incrusting, edges, if free, and the whole undersides covered by a distinct epitheca. *Calices* generally distinct, not lying in valleys, seldom more than two in series, rounded but more commonly polygonal, often pentagonal, varying in breadth from 3 to 6 mm. by about 3 mm. deep, occasionally showing fission but more often budding near their angular corners. *Walls* well defined, thin, solid and nearly or quite imperforate, slightly raised at the angles where three or more calices meet. *Septa* continuous over the pointed walls, varying in number up to about 70, but, if over about 55 in number, generally showing traces of budding, typically then numbering 48, alternately broader and narrower but all of equal thickness, 12 reaching the axial fossa and 12 approaching the same, the rest much smaller, the larger 24 (cycles I., II. and III.) often fusing with one another in pairs or threes, especially when more than 48 septa are present; septal edges and sides roughly granular, no teeth. *Axial fossa* distinct, ·5 mm. broad, closed in below by a mass of trabeculae from the septa, no true columella. In *section* distinct endothecal dissepiments, ·5 mm. or less apart, extending down obliquely between the sides of the septa to the axial fossa. No *synapticula* in the older calices visible from the surface, but walls synapticular in origin and in section a few visible near the same.

Locality. Found sparsely throughout the Maldives (12 specimens), principally on lagoon reefs; only one colony from Minikoi. **Colour** pale yellow-green to olive-brown.

The colonies exhibit considerable variation but all are of massive growth. One is 12 by 8·5 by 8·5 cm., underneath hollowed out and completely clothed with epitheca, above with calices 3—4 mm. in diameter, nearly all showing intracalicular budding. A second is an incrustation, having calices 4—5 mm. deep with a tendency to elongate and to divide by fission forming valleys 8—12 mm. long with 2 to 4 centres. Others have no free edges, one being entirely massive with corallum 8 cm. thick; the diameter and depth of the calices vary, and in some bud formation is scarcely visible. In yet others the surface is so closely covered with barnacles, imbedded in the corallum, that the specific characters of the species are lost. One specimen, further, has marked differences in the thickness of the septa of the different cycles, recalling some species of Pavonia.

var. minikoiensis *nov.* (Pl. XC. fig. 7.)

One specimen is remarkable and may represent a true variety. It is a complete colony, 11 by 10 cm., one side partly incrusting a dead growth of the same, but the rest extending

[1] "Ostafrikanische Steinkorallen" von Dr E. von Marenzeller, *Mitt. natur. Mus., Hamburg*, p. 124 *et seq.*, 1901.

out freely, the whole nowhere more than 1 cm. thick. Its calices average 6·5 mm. in diameter by 2·5 mm. deep, and there is a tendency to form near the edges valleys parallel to the same, 10—15 mm. long, with 3—5 calices. For the rest there may be an extra cycle of septa (V), which at their inner edges fuse to IV., and all the septa owing to the larger and shallower calices appear more even and thicker than in the type.

There is no form absolutely intermediate between the above and the type, but a few smaller and recently budded off calices seem to a small degree to connect it. It is, I think, a true variety, but this, although I have so treated it here, is doubtful in the absence of more specimens. In no case, however, can I regard it as a distinct species, no structure of importance really appearing to be different.

Locality. Minikoi lagoon, under a mass of rotten Porites. **Colour** very dark olive-brown.

Genus *Fungia.*

The specimens in the collection are clearly divisible into three species, between which I do not find any intermediates. As will be seen below, I cannot accept Döderlein's absorption of the genera Cycloseris and Diaseris into Fungia. In the latter there is no regular fusion of the septa of higher cycles to those of lower as in the other two genera, and the presence of direct communication between the two sides of the polyp through cavities in the theca implies considerable physiological differences. An analogous arrangement of septa in series to that described below in F. dentigera appears to be very characteristic of the genus. Under F dentigera and fungites below, I think I have sufficiently expressed my views in respect to Döderlein's monograph of the genus (*Abh. Senck. nat. Gesell.*, XXVII.). It is quite clear that that author has, generally speaking, no scientific basis for his descriptions of "varieties."

7. Fungia dentigera (Leuckart).

Dana, p. 301, XVIII. 4, Ed. and H., p. 17, and Gard., 1898, p. 527.

Fungia scutaria Link. var. dentigera Döderlein, *Abh. Senck. nat. Gesell.*, Bd. XXVII. p. 97, T. VIII. fig. 1 u. 6 (1902).

Sixty-five specimens in the collection are clearly referable to this species or variety, and there are a number of young forms (less than 10 cm. in length) which appear to belong to it as well; in the following remarks the latter specimens will be neglected, unless otherwise stated.

The *coralla* vary in length and breadth from 10 by 7·5 cm. to 19·5 by 13·5 cm., the relation of length to breadth in the whole series being 100 to 71. The height, standing on a table, varies from 2·5 to 8·5 cm., and the depth of the axial fossa from 1·3 to 2·7 cm., while its average breadth is 8 mm.

The *tentacular lobes* of the septa, arising above the general level of their edges, form the main character of the species, but there is no regularity in the positions at which they are given off, so that the whole surface appears to be studded with them. Outside of where they arise, their septa attain the same height as the others, but towards the axial fossa continue for some distance at a lower level. The arrangement is such that there is always a fine septum at a lower level between neighbouring, upstanding septa. In places where the lower surface is much concave, or there is any irregularity in the corallum, some of the septa may not be continued beyond their tentacular lobes to the edge of the disc.

The *septa* may themselves be divided into five series: (I.) 48 ending against the axial fossa almost or quite perpendicularly except at its ends; (II.) other 48 with perpendicular edges, commencing about 2 mm. further out from the axial fossa, often in large specimens approximating in size to series I., to which they also agree in possessing no tentacular lobes; (III.) 3 mm. further out, 96 very fine, thin septa with edges 5—10 mm. below those of I. and II., rising perpendicularly at a distance of 1 to 3 or even 4 cm. from the axial fossa into blunt, tentacular lobes (see below), after which they become similar to I. and II.; (IV.) 192 septa (number often incomplete) starting similarly to III. and at the level of their tentacular lobes, and arising in 1, 2, or 3 cm. into tentacular lobes and continuing outwards as the previous cycles; and (V.) 384 septa if complete—largest specimens about 150 present—recognisable only at the edge of the corallum, arising similarly to series IV. The above is the adult condition, but in development the regular arrangement into cycles 6, 6, 12, 24, 48, etc. is clearly recognisable.

The *axial fossa* appears rather granular at its base, owing to spines arising from the edges and sides of the septa. The synapticula are about 1 mm. apart and at least 3—5 mm. below the free edges of the septa.

Locality. The species is abundant both at Minikoi and Hulule. It is found in protected situations on the reef-flat and boulder zone, but more particularly frequents the crevices and hollows under and between large colonies of other species of corals in the lagoons. Throughout the Maldives it is fairly common but rather local. One large specimen, of which the one half of the upper surface of the disc including the axial fossa had been killed by silt, is interesting as showing in seven places attempted growths of the living edge of the polyp over the sand to reform the mouth and disc. **Colour** olive-green, tentacles more transparent, often somewhat whitish.

The specimens exhibit *vegetative* variation in contour, height, character of edges, and to some extent thickness of septa, and of the spines of the under surface. The variations entail the breaking up of the septa in places (see above), the elongation or restriction of the axial fossa, and the prominence or reduction of the costae. While vegetative variation is probably in most of these characters superimposed on *continuous*, the latter is only clearly recognisable in the last two features; however, the characters of the costae throughout clearly belong to the type figured by Döderlein.

Each corallum exhibits more or less its own character in the nature and thickness of the septa and of their teeth, and especially of the tentacular lobes of the same. The edges of the septa are generally finely toothed, 25—40 in 1 cm., the teeth rising up to 5 mm. in height, but are sometimes almost smooth. The tentacular lobes, while generally 3—5 mm. broad and rising perpendicularly from the interior, may be rounded above or almost square, projecting up to 1, 2, or 3 mm. above the general level of the septal edges, markedly thicker than the rest of the septum or of the same thickness, and separated by a distinct notch from the rest of the septum or without any such notch. These lobes to some degree increase in size with age, in young specimens being little marked, but in all the 65 specimens, with the exception of one rather delicate, flat form from Hulule, can only be described as *markedly conspicuous*.

In no character do the specimens exhibit *discontinuous* variation. The species may be nothing more than a *variety* of F. scutaria, but it is quite obvious that Döderlein on his apparently very limited number of specimens had no justification in so characterising it. If that author be correct, the number of specimens in the present collection points to the probability that he is dealing here with a *true variety*, the separating characters of which

are discontinuous, and not with an arbitrarily chosen point in a continuous series of variations, selected for him by the ignorance or caprice of the collectors, whose specimens he examined. I did not make any particular point of collecting Fungids, but my specimens represent all that I actually brought to land. The clear definition of the series of 65 specimens under consideration points to F. dentigera being in any case a clearly defined variety or species in the Maldives.

8. Fungia fungites (Linn.).

Ell. and Sol., *Zooph.*, p. 129, and Döderlein, *Abh. Senck. nat. Gesell.*, Bd. XXVII. p. 136 *et seq.* Fungia patella Ed. and H., III. p. 7, Klz., p. 61, VII. 4, and Gard., 1898, p. 526.

I refer 59 specimens to this species, but I am quite incapable of recognising any definite "varieties" among them. They are undoubtedly the same as Klunzinger's F. patella, but, while varying within considerable limits, appear as a general character to possess rather sharper and more pointed teeth and spines.

Döderlein's synonymy appears to me to be approximately correct, but I am not really entitled to express any opinion thereon owing to the limited number of Fungids that I have examined. I do not, however, follow that author or Klunzinger in dividing the species up into varieties. In such a matter it is difficult to express any opinion without the actual specimens examined by each author before one, and the difficulty is enhanced when the actual numbers of specimens of the type and of each variety, examined by each author, is not definitely stated. From a consideration of the general problems connected with variation in the Madreporaria, I see no reason to consider any of Döderlein's 13 varieties of the species under discussion as representing other than either *vegetative* variations or points in *continuous* series of variations in different directions, neither of which being stable can *sensu stricto* be termed "varieties." Except young forms none of my specimens are absolutely identical with any of the *so-called* varieties figured and described by Döderlein, though individual specimens could reasonably be picked out (were the rest destroyed) as belonging to 8 or 9 of such. The variation, indeed, in all my specimens is either *continuous* or *vegetative*, so that all scientifically must be referred to a single species without any varieties.

I can add nothing either to the description of the species as given by Döderlein, or to the account of its normal (vegetative and continuous) variations as expressed by the same author in his descriptions of its so-called varieties. As compared, in its septal arrangements, with *F. dentigera*, series I. has 24 septa, and there is an additional series between I. and II. likewise of 24 septa. The septa arise in the same way and pursue a similar course, and in most specimens there is some trace of a tentacular lobe, either a low angular or square lobe, or simply an absence of dentitions for 3 to 4 mm. One of the largest specimens, 18 by 16 cm., has about 860 septa, thus containing a few belonging to a sixth series.

The coralla vary in length and breadth from 5·5 by 5 cm. to 18·5 by 16 cm., the relation of length to breadth in the whole series being 100 to 87. The height standing on a table varies from 1·5 to 8·5 cm. and the length of the axial fossa is $\frac{1}{4}$ to $\frac{1}{5}$ the length of the corallum, while its breadth is generally less than 5 mm.

Locality. The species is found in positions similar to *F. dentigera* and is equally common in the groups. A single rounded specimen, 5 by 5 cm., was obtained from 40 *f.* on the outer slope of a shoal in Suvadiva Atoll; it was still alive, but had probably been swept off the surface of the same shoal. **Colour** green, often with a tinge of gold.

9. Fungia danai Ed. and H.

Fungia echinata Dana, p. 294, XVIII. 8 and 9. F. danai Ed. and H., p. 11, D. 10, fig. 1, and Döderlein, *Abh. Senck. nat. Gesell.*, Bd. XXVII. T. XIV—XVIII.

I refer four specimens to this species, from which F. scruposa Klunzinger does not appear to be clearly separable. They differ considerably from one another in thickness of septa, teeth of same, thickness and roughness of the costal spines, etc., the smallest specimen, the peristomial surface of which has been killed in three places, being markedly coarser in these respects. The specimens are all approximately round and somewhat convex above, and measure 26, 18, 15 and 13 cm. in diameter with respectively about 660, 464, 430 and 380 septa. The septa in their cycles are very irregular; the first 12 reach the axial fossa, but the second 12 (cycle III.) almost equal them in size. The septa of cycles I.—IV. (6, 6, 12, 24, in all 48 in number) are generally without the tentacular lobes, which are present in all higher cycles. The septa consist of lower and higher portions, the latter following outside the tentacular lobes, but they differ from F. dentigera and fungites in that the septa, which lie next to the largest 24 (cycles I. to III.) always extend close in to the axial fossa, and generally, in running outwards, remain next to them, only rising into paliform lobes 1—2 cm. from the edge of the corallum. They seem generally to belong to cycle VII., which thus extends further into the corallum than IV. The same is likewise true of the septa on either side of those of cycle IV. in respect to those of V.

Locality. All from the sand-flat or boulder zone to the south of Minikoi lagoon. **Colour** brown-green.

Genus *Podabacia.*

Ed. and H., *Compt. rend. de l'Acad. des Sc.*, T. XXIX. p. 71, 1849, and *Cor.* III. p. 19, 1860. (See also Duncan, *Jour. Linn. Soc.*, XVII. p. 155, 1884, and Studer, *Zool. Jahrb.*, Bd. XLIV. p. 405, 1901, in which *Podabacia* and *Halomitra* are joined together.)

It appears to me that the absorption of Podabacia into Halomitra is forced, and cannot be, scientifically speaking, supported in any way. It implies that we suppose that the budding off of Halomitra from a fixed stock took place absolutely independently of that of Fungia, and that Podabacia is a form which has retained the primitive fixed character. Firstly, there would be the development of the multicalicular character, and, secondly, there would arise in some forms the power of cutting off discs from the fixed stock. It is, however, almost certain that the young Halomitra is cut off from its stock as a simple Fungia, and, if the two genera (Halomitra and Podabacia) are identical or especially related in contradistinction to Fungia, we must regard the simple corallum of the young Halomitra as due to secondary evolution acting on the forms in their larval condition. On the other hand if the simple, young corallum is primitive—and I think that in the absence of information to the contrary we must so regard it—it is clear that the multicalicular character is due to parallel evolution in the two genera. Fungia would then be a form, which has retained its simple condition, and from which Halomitra became differentiated after the power of budding from a fixed stock had been acquired. Podabacia on the other hand retained the primitive fixed condition, and independently acquired its multicalicular character.

Podabacia is a typical member of the family Fungidae (Duncan, *Jour. Linn. Soc.*, XVIII. p. 141) in all its characters. In alone of the family retaining the primitive fixed condition

it represents in any *scientific* classification a distinctly lower position than any of the other genera of the family. In that it had evidently, before it began to acquire its multicalicular character, attained its family characters in distinction to the Lophoseridae, the assumption would be that the discoid forms—and indeed all the forms—of the latter family arose absolutely independently of the genera of the Fungidae. The striking relationship between some of the genera of the two families (beyond the characters common to both and the group Fungida) would have then been later acquired, and give indeed most remarkable instances of how widely separated forms living in the same environment develop along parallel lines.

10. Podabacia crustacea (Pallas). (Pl. XC. fig. 8.)

Ed. and H., III. p. 20, and Duncan, *Jour. Linn. Soc.*, XVII. p. 155, Pl. VI. figs. 1—5.

The collection has 11 complete colonies of this species, and pieces from at least nine other colonies. The smallest is a round disc, 10 mm. in diameter, closely resembling a small Fungia with a very broad base of attachment. The next, 16 mm., shows the commencement of the secondary calices. New calices arise by budding at the edge, or in older coralla by fission of pre-existing calices at right angles to the line of growth of the corallum in their neighbourhood. The corallum may be almost flat, cup-shaped, or bending back over the rock, on which it is attached, or growing out as a crinkled leaf or irregular cup at right angles to the same. The specimens show considerable variation in the presence or absence of distinct teeth on the larger septa round the axial fossae, and in the thickness, granulation and spinulation of the septa.

Locality. Goidu, Goifurfehendu, 5 colonies from outer part of reef-flat, one at base of a colony of Pocillopora, and Minikoi, very common at one spot in a small area of rotting coral on the sand-flat to the south of the lagoon, ½ mile W. of Wiringili islet, mostly from the bases or under surfaces of the coral masses. **Colour,** stomodoea white, 1—2 mm. long, tentacles round, blunt, transparent processes over the ends of the 6—8 septa next the stomodoeum, upper surface light to dark brown with yellow tinge, more green where exposed to the sun, underside white with streaks and shades of brown.

Genus *Halomitra*.

11. Halomitra philippinensis Studer.

Halomitra (Podabacia) philippinensis Studer, *Zool. Jahrb.*, Bd. XLIV. p. 414, T. XXVII. and XXVIII.

There are three specimens in the collection which belong to this species, the description of which is admirable but the figures rather confusing owing to their reduction and flatness, i.e. want of perspective. The right of the figure on T. XXVII. above gives the most accurate representation of the calices in my specimens, but the latter are all in every part much rougher than the type, septa more markedly incised between and more elevated around the secondary calicular centres, costal spines rougher, often branching.

The specimens measure (I.) 33 cm. long by 27 cm. broad and 18 cm. high, (II.) 23 by 15 and 9 cm., and (III.) 11 by 8 and 3 cm. No. I. has the central calice and part of the stalk still remaining; they are situated close to one side, which appears to have been broken off and to be regenerating. No. II. is a broken off side of a similar specimen to no. I., which has itself reformed its broken side, while no. III. is a similar but much smaller specimen; neither II. nor III. have any trace of the central calice, which cannot apparently be regenerated.

Locality. The specimens were obtained between growing masses of branching corals on lagoon reefs at Goidu (no. III.) and Turadu, S. Mahlosmadulu.

Genus *Herpolitha.*

A single specimen is very doubtfully referred to this genus. The central fossa is divided up but the septa radiating from it are not broken up in any way. I find my justification for the course I am now adopting in four specimens of Herpolitha limax in my possession from Singapore, collected by the late Mr F. P. Bedford. The largest of these specimens, 28 cm. long, has all the regular characters typical of the species, while the three smaller show stages leading up to it from the originally fixed form. The smallest specimen, 7·2 by 3·5 cm., with the scar of attachment still quite fresh, has its axial fossa continuous from end to end of the corallum, but broken up in 4 places by septa having fused across; the septa further extend generally unbroken from the fossa to the edge, though they are depressed in places. The other two specimens, 15·5 and about 21 cm. long, show how the coral in its subsequent growth becomes quite convex above, and how its axial fossa and septa become broken up, though the line of the former can always even in the adult be clearly seen.

The form described below has retained the condition found in the newly broken off disc of H. limax. It is possible that it is the young form of some species of great size, but the absence of any trace of the scar and of any incipient breaking up of the septa lead one to believe that it is a form which has retained its primitive characteristics, that has fixed within itself one of the early stages of the evolution of Herpolitha from Fungia. Its characters—particularly the arrangement of the septa and the septal teeth—are such that it certainly can belong to no described species that I have found, and so it in any case must be described as new.

12. Herpolitha simplex n. sp. (Pl. XCI. fig. 13.)

A *Herpolitha* with the *axial fossa* 1—2·5 mm. broad, continuous from end to end of the corallum as a deep valley, broken up in places, about 2 cm. apart, by the septa of neighbouring sides thickening at their ends and fusing across. *Columella* in the centre 8—10 mm. below the tops of the highest septa, formed of fine, rounded rods, distinct in the centre and, immediately outside each septal fusion, passing gradually into septa running for some distance longitudinally at the bottom of the fossa, one at each end of the latter extending to the edge of the corallum and apparently really continuous at the base of the fossa from the first septal fusion to the edge. *Septa* of four series, (I.) bending round from the axial fossa and extending to the edge of the corallum, (II.) intermediate to the last, arising to the same height and character at about 5—10 mm. from the axial fossa, (III.) pairs on either side of the last, always much thinner and rising farther out, at least one of the pair extending in nearly to the axial fossa, sometimes fused together at the end and with septa II., and (IV.) very small, paired on either side of the last and fused to same at a varying distance from the edge of the corallum. Septa of series I. and II. relatively thick, subequal in height, sides rough, edges with rough teeth 1—2 mm. high, generally blunt, 3 to 4 in 1 cm. *Under surface* low, subequal, granular spines, in radiating lines corresponding to the costae of septal series I.—III., irregular only in the centre. *Theca* relatively little perforated.

Length 25 cm., breadth in centre 6·5 cm., greatest breadth 7·2 cm., thickness of corallum from under-surface to tops of septa 6—10 mm., height on table 5 cm., and septa about 1150 in number.

Locality. S. Nilandu, 25 *f.*

Genus *Cycloseris.*

I see no reason to change my view as to the distinctness of this genus from Fungia (Willey's *Zoological Results*, p. 171 *et seq.*, 1899). The successive fusion of the septa of the higher cycles to those of the lower with the exception of the first three or four cycles (24 or 48 septa), and the elevation of the edges of the intervening septa to the same level as those of the larger septa (i.e. lower cycles) immediately after this fusion has taken place, is further a most characteristic feature of the genus.

13. Cycloseris sinensis Ed. and H. (Pl. XCI. figs. 14—16.) *Cor.* III. p. 51.

The *corallum* is circular or slightly oval, a little concave or flat below, convex above, always rising considerably around the axial fossa, sometimes only the central part elevated, being surrounded by the almost flat spreading edge. The *costae* are very fine and granular, and extend to the original point of attachment of the corallum; they are either subequal or give indications of three series, being thus divided into groups of four. The *axial fossa* is oval, two or three times as long as broad, closed in below with fine papillae. The *septa* vary in number with the size of the corallum. The first cycle is clearly distinguishable, one at each end and two pairs at the sides of the axial fossa, the latter pairs in small specimens having a tendency to meet each other across the axial fossa. Those of the lowest cycles are thicker and more elevated (I. and II. subequal and 1 to 2 mm. higher than III.) towards the centre of the corallum; their edges are finely toothed, sides granular.

Locality. Mulaku, 27 *f.*, muddy bottom, three specimens respectively 54, 42·5 and 19 mm. long, 52·5, 40·5 and 18 mm. broad, 12·5, 10·5, 8 mm. greatest height with about 340, 330 and 190 septa; S. Nilandu, 30 *f.*, broken ground, one specimen 33 mm. long, 29 mm. broad, 12 mm. high with 270 septa. **Colour** none, greyish-white owing to the corallum.

The two largest specimens were evidently living under unfavourable conditions. Their under surfaces were partially dead and the axial fossa of the second was penetrated by a worm. The septa of both are accordingly thicker and coarser than the other two. If a rim of 10 mm. in width were cut off the edge of the largest specimen, it would be practically identical with the S. Nilandu specimen in all its characters.

The species closely approaches *C. hexagonalis*[1], but differs from that species particularly in that the young free stages are round, concave beneath and convex above, and relatively thick owing to the upstanding septa. These characters are retained in the central part of the adult corallum, though the under side may become more or less flattened. The whole too may by the outgrowth of the edge as a flat plate acquire secondarily an appearance approaching to *C. hexagonalis.*

14. Cycloseris cyclolites (Lmk.). (Pl. XCI. figs. 17—19.)

Ed. and H., III. p. 50, D. 12, fig. 3, and Quelch, *Challenger Report*, p. 121. Fungia cyclolites Döderlein, *Abh. Senck. nat. Gesell.*, T. XXVII. p. 77, IV. 7—9 and V. 5.

This species differs from all others of the genus in the marked thickness of its corallum, even convex upper surface, thickness and coarseness of its septa, of which the first 12 at least are subequal, reaching the axial fossa. At first sight it would naturally be referred to the genus Fungia, but it has all the morphological characters of Cycloseris.

[1] Willey's *Zool. Results*, p. 171 *et seq.*

As may be seen from the accompanying table and the figures, the specimens in the collection are much more irregular than those described by Döderlein.

No.	Length	Breadth	Height	Length Axial Fossa	No. of Septa	Locality
1.	65 mm.	59 mm.	22 mm.	19 mm.	316	Pearl Banks, Ceylon
2.	52 mm.	49 mm.	24 mm.	15 mm.	310	Hulule
3.	49 mm.	47 mm.	23 mm.	19 mm.	270	,,
4.	37 mm.	37 mm.	25 mm.	14 mm.	210	,,
5.	36 mm.	33 mm.	13 mm.	11 mm.	185	,,
6.	41 mm.	36 mm.	23 mm.	20 mm.	190	Turadu, Mahlosmadulu
7.	38 mm.	34 mm.	15 mm.	15 mm.	205	,,

Genus *Diaseris*.

The division up of the corallum into segments, each of which includes a part of the axial fossa, seems to be in certain species of Fungids a regular and normal method of reproduction by asexual means. My specimens do not unfortunately show how budding takes place from the original stock (*anthocaulus*). Some of the specimens seem to me to have traces of the original scar, and it would hence appear probable that the original divisions took place at the same time as the disc (*anthocyathus*) separated from its stem. In any case the peculiar adult condition and the presence of such a remarkable method of asexual reproduction appear to me to be sufficient to separate the forms off from Cycloseris or Fungia as a distinct genus. Of course, it is probable that were specimens of either of these latter genera split up mechanically from the centre, the pieces would regenerate in a similar manner. Indeed I have such a specimen of a massive Fungia before me (the presumably original section of which is 9·5 by 14 cm.) which is completing itself, having grown out a fresh piece 5 cm. across. Such specimens, however, are exceedingly rare, while the large number of specimens of a single species of *Diaseris* in the collection show that it is in that genus a normal method of reproduction.

Of course the genus *Diaseris* approaches much closer to Cycloseris than to Fungia. Indeed, it resembles the former in its imperforate theca and in the general arrangement and fusion together of its septa.

15. Diaseris distorta Michelin.

Ed. and H., III. p. 55, T. D. 12, fig. 4. Fungia distorta (Diaseris-Form) Döderlein, *Abh. Senck. nat. Gesell.*, T. XXVII. p. 74, T. III.

The specimens (166 in number) generally resemble the figures and descriptions of the above authors. Most of them have the costae rounded, subequal and very small, but in some of the largest they are more conspicuous, alternately larger and smaller. The septa, where they rise up to the general level and the tentacles come off, are generally a little thickened, but may form definite little tentacular lobes. At the edges of the coralla the septa are everywhere alternately lower and higher, longer and smaller.

Locality. The specimens were found either on a bottom of fine rubble (not sand), of hard rock or mud, generally in or near passages into the lagoons of the atolls. Those from rubble are generally coarser in texture (costae and septa) and larger than from mud, but all kinds may occur together. Suvadiva, 38 *f.*, 4 specimens; S. Nilandu, 36 *f.*, 2, 24 *f.*, 5 and 25 *f.*, 47; Mulaku, 25 *f.*, 2, 42 *f.*, 1 and 30 *f.*, 1; Felidu, 25 *f.*, 1; N. Male, 25 *f.*, 68; and Mahlosmadulu, 22 *f.*, 1. **Colour** light grey-green.

Genus *Pavonia*.

Only massive colonies of this genus were obtained, and it appears to me to be questionable, whether its massive and incrusting species really belong to the same genus as the branching, a point which can only be settled by an examination of the anatomy of their polyps.

16. Pavonia repens Brüg. (Pl. XC. figs. 9—11.)

Abh. nat. Ver. Bremen, Bd. v. p. 395, VII. 1; Klz., p. 75, IX. 3; P. repens et intermedia Gard., p. 531, XLIV. 2 and 3.

The present collection contains 31 specimens, which show extraordinary vegetative variability. All, however, can be clearly connected together by the examination of the calicular characters on different parts of their surfaces. P. intermedia may be a form of the same species, which has grown into knobs, much bored into by worms, etc., i.e. has grown under most unfavourable conditions. In no specimens in the present collection are the calices so much circumscribed, etc., but several which have apparently grown under similar conditions approach it. In any case I now know that it should not have been described on a single specimen, and I consider that its characters are not beyond the limits of vegetative variation (perhaps acting on continuous) in this species.

There are not enough specimens to distinguish between vegetative and continuous variation in P. repens but the chief differences may easily be seen:

(1) *Form of growth:* thin, incrusting, where the base of support is exposed at low tide, or where growing under another coral and striving to reach the light, or where the surface is much distorted by small barnacles; massive, round heads, 1 foot or more in diameter, where growing quite freely; and all intermediate stages to the incrusting, many with knobs and elevations, in intermediate situations.

(2) *Collines:* sharp, high, irregular, much broken, often with more than one line of calices between, due to vigorous budding, with about 24 septa in 5 mm. on rounded heads and vigorously grown specimens; low, rounded, even, regular, very meandering with about 30 septa in 5 mm., where growing in muddy currents, or where swept by the tidal mud; collines absent and calices circumscribed and distant, smooth even surface on the undersides of large specimens or where growing in dense shade; ridge-like walls, only forming collines here and there, much circumscribed calices, where specimens distorted by barnacles or boring organisms, and also clean specimens when growing near the edge of the reef where the waves break.

All the intermediate stages of any of the characters given above may be found in the same or in different colonies, certainly in the Minikoi colonies alone. Yet the species appears to be quite well-marked by its massive and incrusting form of growth and the characters of its septa and columella.

Locality. An important builder on nearly every reef, both against the external ocean and the lagoon and on nearly every shoal in the Maldives and Minikoi, growing on the outer slope, the reef-flat, the sand-flat behind the boulder-zone, and at the bases and between other corals on even the most luxuriant lagoon reefs, often partially exposed at low tide, often growing in the strongest currents and perhaps less affected by sediment than any other *true reef-coral*; Addu, outer slope of atoll, 40 *f.*; Miladumadulu 25 *f.*; and S. Nilandu,

25 *f.* **Colour** golden yellow where exposed to the sun, dark brown in dense shade, both varying to yellow or brown-green.

Genus *Leptoseris*.

The genus appears to me to be distinguishable from *Pavonia* by the thin character of its growth, in its being unifacial in respect to its calices, by the absence of crests and lines of calices and also of any definite mural structures, either synapticular or other. Further, the subequal septa, much echinulated on their sides, and branching or twisted between the calicular centres, serve to separate the species at once from their nearest allies among the incrusting forms of *Pavonia*. These differences, too, almost certainly imply considerable divergences in the polyps of the two genera, and in the absence of information on this head are amply sufficient for their separation.

17. Leptoseris fragilis Ed. and H. (Pl. XCII. fig. 24.)

Rousseau, *Voy. au Pôle sud de Dumont d'Urville, Zool.* t. v. p. 123, Pl. XXIX. fig. 1; Ed. and H., III. p. 76.

I refer three specimens to this species. One is a regular saucer, 6 cm. in diameter, with 10 calices, attached in the centre by a broad stalk, and the second is also of the same shape with 4 calices; the third is an almost flat plate, likewise attached in the centre, 8 by 6·5 cm., with about 30 calices. There is no conspicuous central calice as in one of the specimens figured by Rousseau, but there are indications of such an one in two of the three. The *septa* are alternately larger and smaller, and vary in number from 18 to 24 and even to 30 in the flattened specimen; they run into straight septocostae at the edges of the corallum, but at the sides and between the calices, where they are very crowded, twist and bend somewhat. The calices at their rims tend to be raised up into round pads, especially towards the centre of the colony, but this is less marked in the saucer-like specimens; their size varies up to 5 or 6 mm. in greatest diameter, the axial fossa rarely being more than 1 to 2 mm. The columella is relatively large, formed of twisted, flattened trabeculae.

Locality. Suvadiva, 38 *f.*; S. Nilandu, 30 *f.*; and N. Male, 20 *f.*

18. Leptoseris papyracea (Dana). (Pl. XCII. fig. 23.) Dana, p. 323, XXII. 3.

I refer a single branched leaf to this species; it is 8 cm. high, 2 cm. broad at the base, branching out to 10 cm. at the summit, and has 18 calices scattered much as Dana figures. The broken base is 4·5 mm. thick, tapering to the edges. The underside is finely granulated all over, broken up into low rounded lines or costae extending up from the base, more appearing in between as the corallum expands, about every fourth a little more conspicuous. The *septocostae* of the upper side are very low and rounded, alternately larger and smaller, the larger with finely granulated sides, none toothed. The *calices* are rather oval in a direction transverse to the growth, about 5 mm. long; their lower sides are raised into rounded lips, so that they open more or less upwards. The *septa* number about 24, higher and lower distinctly alternating. The axial fossae are about 2 mm. long, closed in below by upstanding, twisted plate-like columellae.

The specimen differs from L. fragilis in its mode of growth, the arrangement of its costae and in its oval shaped calices with lips beneath and septa markedly alternating in size.

Locality. Suvadiva, 30 *f.*

19. Leptoseris incrustans n. sp. (Pl. XCII. fig. 25.)

Adult characters. *Corallum* closely incrusting the surface over which it is growing, never attaining any great thickness, edges sometimes free for a few mm., marked underneath by faint, subequal costal lines. *Upper surface* rough, to some extent following perhaps the contour of the block on which the colony is growing, but sometimes rising irregularly into low knobs and rounded elevations at the angles where three or more calices meet one another. *Calices* with broad, rounded, rather flattened walls, small deep axial fossae, which are generally at least 4—5 mm. distant from one another, closed in below by rounded or oval *columellae*. *Septa* 12—18, subequal, no division into cycles, running at the edges of the colonies into linearly extending septocostae, continuous between the calices over their walls, sometimes meandering or branching or connected transversely at the angles between the calices; edges of septa untoothed, sides very rough and granular, interseptal spaces very small. *Increase* by budding over the walls and at the edges of the colonies. In *section* corallum with an appearance of rather a fine network, due to the numerous, regular, coarse synapticulae.

The corallum recalls *Pavonia explanulata* (Lmk.), Ed. and H., but differs in its absence of ridges and its subequal septa. The arrangement of the septa over the dividing walls is similar to Domoseris porosa Quelch (*Challenger Report*, Pl. v. fig. 4 *a*) and also to Leptoseris fragilis above. Indeed, it appears to be characteristic of the more incrusting members of the genus, being hardly more than recognisable in the leaf-like forms, quite clear in those of cup-shape, and the incrusting forms by its means adapting themselves to their mode of growth without altering the character of their calices. In the youngest stages, as will be seen below, it does not occur, all species at first probably presenting close similarities. In fact, the examination of the young forms and that of the original specimens causes one to suspect the generic separation of Domoseris Quelch from the genus under consideration.

Young stages. There are 20 young specimens, which probably all belong to the same species, though as to the specific identity of which one cannot be absolutely certain. They vary from single calices of less than 1 cm. in diameter on the one hand to a form less than 3 cm. across, with very distinct radiating septocostae at its edge, with no central calice but with a little mass of calices having the adult characters in the centre, and on the other hand to a form still larger, with a large, central calice, radiating septocostae still dominating in every part, but with the commencement of very numerous daughter calices.

The corallum clearly starts with a single calice, which spreads at its edges over its basis of support. When fully formed, it has upwards of 30 subequal septa, each branching one or more times to form the septocostae. If the larva in the first place settles on a suitable rock, which it can incrust in its growth without its edges being free for more than 2 or 3 mm., its central calice quickly divides up into 2, but more commonly into 3 calices, which are added to by budding, all being indistinguishable from the adult calices. If the support be unsuitable, and the edge has to grow out to find some additional support, the central calice may grow without dividing up to 2 or 2·5 cm. in breadth or even larger, having perhaps more than 40 septa, and being about three times as large as the ordinary calices of the adult, 12 septa sometimes being rather thicker and more prominent than the rest. Under these conditions the secondary calices, those which arise by budding over the septocostae, may not for some time attain their adult characters, appearing to be distinctly radiating, but subsequently by the division of the central calice into three the adult condition is reached.

Locality. *Adult coralla:* Suvadiva, 43 *f.* (1 specimen); S. Nilandu, 25 *f.* (2); Felidu, 28 *f.* (1); N. Male, 25 *f.* (1). *Young stages:* Suvadiva, 40 *f.* (2) and 20 *f.* (1); S. Nilandu, 30 *f.* (6), 25 *f.* (4) and 19 *f.* (3); N. Male, 25 *f.* (1) and 12 *f.* (1); and Mahlosmadulu, 22 *f.* (2).

Genus *Echinophyllia.*

Klunzinger, III. p. 69. *Trachypora* Verrill, *Bull. Mus. Comp. Zool.*, vol. I. p. 53, 1864, and Duncan, *Journ. Linn. Soc.*, XVIII. p. 159, 1884. (*Trachypora* cannot be correct, being already occupied by Ed. and H., *Cor.* III. p. 315.)

20. Echinophyllia lucera Verrill. (Pl. XCIII. fig. 26.) *Loc. cit. supra.*

A single leaf, 17 by 12 cm., and a fragment with all the characters given for the species. The *theca* is imperforate, except beneath the calicular centres, where slits tend to be present. There are about 7 septocostae in 10 mm. The *calicular centres* lie between the larger septocostae, which tend to run from the centre (or where they commence) unbroken to the margin. These *septocostae* are thick and coarse, with low, thick teeth covered with small spines, and between them lie 3 to 5 lower, the central one often a little spined, forming later, as the corallum expands, a septocosta of the first series. At the ends of the calices the larger septocostae branch or bend inwards, and around the same all the septa, 6 to 12 or 14, rise each into about 3 sharp-pointed spines 2 or 3 mm. high. The *columella* is relatively large, formed by rough trabeculae from the septal ends. *Increase* is by budding near the edge, and by budding or fission in the more central parts.

Locality. Goidu, from a hollow at the edge of the reef, the large specimen above, and a fragment, similar but much less spined, from Felidu, 25 *f.*, possibly broken off from the reef above. **Colour** brilliant green.

Genus *Pachyseris.*

21. Pachyseris laevicollis Dana. Dana, p. 338, XXII. 2, and Ed. and H., III. p. 87.

There are in the collection 5 broken laminae of this species, the largest 16 by 14 cm. They agree in every respect with the above descriptions. In four of the specimens *costae* can only be distinguished with a lens, being round, equal and minute ridges on the under side, but in the fifth are more pointed and at the edge alternately larger and smaller. In the latter specimen too the *ridges* rise about 1 mm. above the base of the axial fossa, while in the others the surface is almost level. There is no columella, but septa from neighbouring ridges fuse across the valleys, giving the appearance shown in Dana's figure. Fresh calices arise by budding on the ridges; they have at first 6 septa, but later 12, sometimes then growing out or fusing together to form a fresh valley. The *septa* are subequal in size, crinkled or straight edges, sides varying in roughness with the height of the ridges.

Locality. Suvadiva, 26 *f.*, 3 pieces and N. Male, 20 *f.*, 2 pieces.

Genus *Coscinaraea.*

The absorption of this genus into Psammocora, proposed by me (*Proc. Zoo. Soc.*, 1898, p. 533), I am now after seven years additional experience inclined to regard as perhaps ill-advised and certainly premature. Yet, the close relationship of the two genera appears to me to be undeniable, but their proper relationship to the rest of the Fungida is doubtful.

22. Coscinaraea monile (Forsk).

Klz., p. 79, IX. 4. C. meandrina Ed. and H., III. p. 204.

A colony, about 6 cm. in diameter, almost precisely resembles the forms described and figured by the above authors. The *calices* are in general 4—6 mm. deep, gradually becoming shallower at the outgrowing edges. The smallest circumscribed calices have upwards of 40 *septa*, but the larger (over 10 mm. in diameter) have generally from 50 to 80 or even more. The septa, which merge gradually into the papillated trabeculae closing in the axial fossa, number more than 12 and commonly about 18.

Locality. Suvadiva, 20 *f.*, rubble bottom.

23. Coscinaraea donnani n. sp. (Pl. XC. fig. 12.)

Colonies of massive growth, spreading at their edges, covered underneath by epitheca clothing the costae, which number about 16 in 1 cm., equivalent to about half the septa, which reach the outgrowing edges of the colonies. *Calices* 6—10 mm. in diameter, rounded, polygonal or slightly gyrose, 1—2·5 mm. deep to the inner top edges of the septa with axial fossa 1—1·5 mm. broad and 1—1·5 mm. deeper. *Walls* synapticular in origin, appearing together with the septa, which are continuous over the same, very blunt and rounded. *Septa* often nearly equal in thickness and height, fusing together in places, typically 48 of which about 12 reach the axial fossa, the full number (48) only found in the largest calices, the rest varying from 24 upwards; septal edges appearing granular owing to low, subequal, bluntly echinulated spines; interseptal spaces equal to septa in breadth. *Columella* false, formed by trabeculae from the septa, arising 1—1·5 mm. below the summits of their inner edges, sometimes ending above in a few (1 to 6) papillae. *Synapticula* in walls and a few near same. *Increase* by budding over the septa and occasionally by fission.

Locality. (1) A half ball, 9 cm. in diameter, dredged by Capt. Donnan, late Master-Attendant at Colombo, between the Ceylon Pearl Banks, near Manar, about 15 *f.* deep, typical in its characters; (2) a small colony with about 60 calices, S. Nilandu, 25 *f.*, likewise typical; (3) edge of a colony with 26 calices, S. Nilandu, 30 *f.*, and (4) a small colony with 42 calices, Suvadiva, 20 *f.*, both with very shallow calices, septa about twice as thick as the interseptal spaces are broad, and columella often with a few low papillae; (5) a colony with about 70 calices, averaging 5—6 mm. in diameter, S. Male, 25 *f.*, with relatively deep calices and septa intermediate between (3) and (4) and the more typical forms.

The main characters, which separate this species from C. monile, are the lesser total number of septa and the lesser number reaching the axial fossa, and the perpendicular edges of the septa against the axial fossa, a character which profoundly modifies the general appearance of the corallum. From C. savigniensis (*Proc. Zool. Soc.*, 1898, p. 538) it is more widely separated, that species representing rather a smaller and denser edition of C. monile. Of the specimens 1 and 2 above represent probably the typical vigorous growth of the species, while 3, 4 and 5, having their calices much filled in below by the deposition of corallum, can scarcely be regarded as typical, nor as having grown in suitable environments.

Genus *Psammocora*.

Gard., p. 533 (non Coscinaraea).

The finely branching species of the genus of which *definite* separating characters have been described are only three in number: (1) P. obtusangula Lmk., Dana, Ed. and H.; (2) P. contigua

Esp., Ed. and H. = P. plicata Dana = P. ramosa Quelch; (3) P. digitata Ed. and H. = P. gonagra Klz. P. planipora Ed. and H. and P. parvistella Verrill should, I think, be redescribed from the *original* specimens or disappear from literature, the characters assigned to them being worthless or insufficient.

To the typical P. contigua I refer 17 specimens and a large number of small pieces and to a *variety* of the same 11 other specimens to be hereafter discussed, and I have in the British Museum, in Ceylon and the Pacific seen specimens, which I believe to belong to the other two species. All three species have, so far as I can see, precisely the same form of growth, incrusting base often subsequently eaten away rising into knobs or definite branching stems, round, angular, or flattened, their twigs blunt, flattened, or twisted at their ends, their sides smooth or set with ridges or small knobs, the branches crowded together and relatively fine or distant and coarse, quite distinct from one another or constantly anastomosing. All three species live in the same environments, the reef-flat, the shallower waters of the outer slope to about 10 *f.*, on the sand flats and shelves round lagoons and on lagoon shoals. On the reef-flat their colonies are small, 10—12 cm. across, either semi-massive with knobs, or consisting of constantly anastomosing branches; on the outer slope they are much branched, sometimes upwards of a yard across by the same in height and on the sand flats they form heads, a foot across, of flattened leaves and branches, sometimes anastomosing, always bound together below by sponges, algae and tunicates, in which numbers of predatory animals dwell.

To the above species I now add a fourth, P. divaricata, which comes from 25 *f.*, and approaches nearest to P. digitata in the structure of its calices. I have seen no large colonies, but the dozen stems in the collection are all rounded, or slightly flattened with no ridges or knobs, ends rounded or oval, never flattened or twisted, branching often dichotomous, branches fine, not more than 1 cm. in diameter, not crowded, seldom anastomosing.

24. Psammocora contigua Esper.

Esper, *Die Pflanz.*, Th. I., *Forts.*, p. 81, T. LXVI.; Ed. and H., III. p. 220; and Gard., p. 536. P. plicata Dana, p. 346, XXV. 2. P. ramosa Quelch, *Challenger Report*, p. 128, VI. 6.

The *growth* has been given above. The *calices* commonly lie in lines up the leaves and branches, arising by budding from one another; they are in no wise delimited, their septa merging into a mass of tissue, false coenenchym, which commonly seems to consist of a network with round or flattened rods arising in and almost filling up its meshes. The *septa* number 6—10, often fused with one another; they are covered on the edges with relatively large, low, rough spines as also are the strands and rods of the coenenchym. The axial fossa is a pinhole-like depression closed in below by a single rounded rod, the *columella*.

The colonies on different parts of their surfaces exhibit extraordinary variation, but any two may merge into one another towards the base or at the apices. They are, however, divisible into two classes, both found in the same localities and environments and both with precisely similar forms of growth. The colonies of the two classes, as already mentioned, merge into one another, yet in the present collection the specimens of each are moderately easily separable by their differentiating characters taken in their entirety. They thus appear to be true varieties of the same species, representing discontinuous variations:—

Type	var. maldivensis
Calices on the sides of the branches and folia in lines, branching in an arborescent manner.	*Calices* crowded together, lines inconspicuous, arborescent branching not visible.
Coenenchym broad lines between the lines of calices, a network with meshes filled by much flattened rods.	*Coenenchym* inconspicuous in amount, mainly a mass of small rounded rods.
Septa reduced to 3 or 4 each made up of 2 or 3.	*Septa* quite separate from one another (6—10).
Columella well below the inner edges of the septa, inconspicuous.	*Columella* rising nearly to the same height as the inner edges of the septa, hence conspicuous.

Locality. Both type and variety important reef builders throughout the Maldives and at Minikoi. Two Funafuti specimens in the Cambridge Museum and three Singapore ones, obtained by the late Mr F. P. Bedford, all belong to the type form. **Colour** grey to yellow-green.

The species is distinguishable from P. obtusangula by its less delimited and smaller calices and lesser number of septa. P. digitata differs in its still more distinctly marked off and larger calices, and also in its greater number of septa, the two or three neighbouring commonly fusing; indeed it resembles P. haimeana grown in a ramose manner.

25. Psammocora divaricata n. sp. (Pl. XCII. figs. 20 and 21.)

Form of growth as given above. *Calices* evenly distributed, 2—3 mm. across, round, polygonal, often pentagonal, slightly depressed towards an axial fossa, of about ·4 mm. in diameter. *Walls* formed by a central row of synapticula with commonly one row in each calice on either side of the same, the whole in angles where several calices meet or where the surface is at all raised up having the appearance of a network with rounded rods in its meshes. *Septa* thick, with small interseptal spaces, about 12 in number, often neighbouring pairs joined near the axial fossa, each of the 12 commonly again branching into two over the walls of the calices; edges of same set with transversely extended, low, rough spines, likewise continuing over the walls. *Columella* a relatively large and distinct central rod, surrounded by about 6 lower and much finer rods opposite the septa, perhaps spines belonging to the same or pali.

Locality. Suvadiva, 25 *f.*, about 10 separate branches; and Addu, 25 *f.*, outer slope, a single small colony.

The form of growth, if a specific character, at once separates the species from all other forms. The species approaches closest to P. digitata, but is separated from it by its well-marked axial fossae, peculiar type of columella and regular calices. The chief variation of importance in the specimens depends on the extent to which the calices are sunken, on some branches being almost level with the surface and on others markedly concave, the latter in all increasing towards the base.

26. Psammocora exesa Dana. (Pl. XCII. fig. 22.)

Dana, p. 348, XXVI. 1; Quelch, *Challenger Report*, p. 128.

I refer three medium-sized colonies and seven smaller growths to this species. They agree in all respects with Dana's description and figures, though fig. 1 b scarcely brings out the character of the calices; the columns also are not so flat-topped, perpendicular and crowded as in fig. 1, which suggests itself to me as representing a colony, the top of which had reached the low tide level. The colour of the living colony and its appearance in spirit are also similar to Dana's fig. 1 a.

The specimens show similar growth variations to those described in other members of the group. The *walls* may be quite distinct with one or more rows of synapticula on either side, or almost have the appearance of a net-work, the latter with open meshes, the *calices* themselves being absolutely superficial or varying up to 1—2 mm. deep. The *septa* typically number 12, alternately larger and smaller, but 6—18 are found; they are not generally fused together in any way. In different coralla they vary greatly in thickness, but the interseptal spaces are relatively large, at least of the same breadth as the septa. The outer parts of the septa are frequently cut off by deep notches, almost appearing as separate rods; for the rest their edges are rough, set with transversely extending, echinulated spines. Trabeculae from the septa close in the axial fossae below, often giving rise to one or more irregular pillars.

Locality. Lagoon reefs of Hulule, Goidu and Turadu, very local, nowhere abundant. **Colour** brilliant, yellow to green.

27. Psammocora haimeana (Rousseau), Ed. and H.

Rousseau, *Voy. au pôle sud de Dumont-D'Urville, Zool.*, t. v. p. 119, pl. xxvii. fig. 1; Ed. and H., iii. p. 221; Klz., p. 81, ix. 5; and Gard., p. 534 *et seq.*, xlv. 1.

The species has already been sufficiently characterised by previous authors, its most noticeable features being its massive form of growth, calices distinct with elevated walls, or, where increase is rapid, in meandering valleys, walls between axial fossae formed generally of a central and two side rows of synapticula, septa about 12 but often branching into 18—24 towards the outer sides of the calice, and columella a central rod surrounded by a series of 6—12 rods lying in front of the septa.

Variation in growth is seen corresponding to the irregularities of the base on which the colony is growing or to boring, etc. organisms, the surface being sometimes smooth and flat when the calices are rather shallow, sometimes mammillated with deeper calices in the valleys. Increase is by fission and intracalicular budding, meandering valleys resulting in accordance with its vigour. Where valleys exist, they are generally shallow and have only a single row of calices, but one specimen is remarkable as the walls form ridges, 2—3 mm. above the valleys, 4—7 mm. apart, with at least two irregular rows of calices.

Locality. The species forms small colonies on the reef-flat and wherever there is a vigorous circulation of water, being rare in the lagoon. In these situations it is common at Minikoi and throughout the Maldives (19 colonies being brought home), but is scarcely a reef-builder. Also a specimen from Haddumati, 32 *f.*, with very well-defined walls and shallow polygonal calices.

IV. TURBINOLIDAE.

The family is represented by 6 species belonging to 4 genera. Of these one, Flabellum multifore, should perhaps be the type of a new genus on account of its polyp having several stomodoea.

Genus *Flabellum*[1].

The new species, described below, might reasonably be made the type of a new genus, having several stomodoea along its axial fossa. The septa, however, do not show any relationship to the same, and it is quite possible that the polyps of other of the described species have the same character.

[1] *Vide* "Marine Investigations in S. Africa," vol. ii. pp. 117 *et seq.*, 1902.

1. Flabellum rubrum (Q. and G.).

Gard., *Marine Investigations in S. Africa*, vol. II. pp. 125 *et seq.*, 1902. Vide also *Proc. Camb. Phil. Soc.*, vol. XI. pp. 463 *et seq.*

I have already treated of this species at considerable length in connection with S. African forms. Four specimens from Suvadiva, 37 *f.*, and 2 from Mulaku, 24 *f.*

var. *stokesi.* (For literature see above.)

Eleven specimens from Mulaku, 6 *f.*, and 24 *f.*, Suvadiva, 31 *f.*, and N. Male, 2 *f.*

2. Flabellum multifore n. sp. (Pl. XCIII. figs. 28 and 29.)

Corallum flattened, tapering to a blunt point by which it was evidently at one time attached; calice much longer than broad or high, higher in centre than at ends, often pinched in on one side. *Epitheca* well-marked with the usual wavy lines of growth. *Septa* ending almost perpendicularly against the axial fossa, where those of the two sides may be crowded together against one another, the edges sometimes bent to one side, sometimes thickened, sometimes a little interdigitating, deep down joined by a few trabeculae not visible generally from surface view. Septal edges untoothed, but in younger specimens often waved, rising into low rounded elevations. *Axial fossa* varying with size of the calice, elongated in correspondence with same.

Polyps, several stomodoea along the centre of the disc, though the dried corallum has no trace of more than a single mouth. Septa and mesenteries alternating. Tentacles one row round disc, which rises up for 1 to 2 inches above the corallum, apparently equal in number to the septa.

The accompanying table shows the number of septa in relation to the size, etc. of the coralla.

No.	[1]Length of Calice	Breadth of Calice	Height to centre of sides	Height, sides above ends	Depth of Axial Fossa in centre	No. of Growth Rings	No. of Stomodoea	No. of Septa	Remarks
1.	160	38	73	32	18	14	7	302	One side bent in, Pl. XCIII. fig. 28.
2.	80	33	57	25	24	10	4	196	One side a little bent in, Pl. XCIII. fig. 29.
3.	62	24	40	14	23	8	3	182	Sides almost regular, only a trace of bending.
4.	47	19	32	19	16	7	2	174	One side bent in.
5.	41	20	37	5	17	6	2	138	Even and regular.
6.	39	22	33	3	16	6	1	126	Even and regular.
7.	33	21	29	2	12	5	1	96	Distorted, one side broken.

[1] All measurements in millimetres.

The spirit specimens number eight, two being of approximately equal size and similar in shape to no. 1 above, each with 8 mouths, while a third is intermediate in size between nos. 1 and 2 and has 7 mouths.

Locality. Addu Atoll, 28 *f.*, edge of outer reef where it drops off into deeper water, bottom hard rock, 15 specimens; and Mahlosmadulu, 24 *f.*, one broken and partially dead specimen. **Colour** dark green.

Genus *Tropidocyathus* Ed. and H.

Tropidocyathus Ed. and H., *Ann. des Sc. Nat.*, 3e sér., t. IX. p. 327 (1848) and *Cor.* II. p. 57 (1857).

3. Tropidocyathus cooperi n. sp. (Pl. XCIII. fig. 30.)

Corallum compressed, free, with a scar of former attachment and two wings, formed by extensions of the theca, stretching up from the base for a distance corresponding with mode of growth. Sides ridged with low, slightly granular *costae* corresponding in number to the septa and extending out on to the wings.

Septa of five cycles, the last incomplete (6 + 6 + 12 + 24 + 10), those of cycle V. lying on either side of the quaternary septa nearest to the two terminal septa of cycle I. All 1—2 mm. exsert above the top of the theca and forming two series, those of cycles I. and II., ·5—·75 mm., more exsert and extending for about the same distance further into the calice. *Pali* in correspondence narrower before cycles I. and II., but before cycle III. broad plates, not present before the quaternaries except where quinaries are present.

Columella an oval area in the centre of the calice, a third to two-fifths of its length by a quarter to a fifth of its breadth, filled by fine, even-sized pointed spines (fasciculate type), the whole about 1 mm. below the tops of the pali and 3 mm. below the edge of the theca.

Height of specimens, 17 and 30 mm.; diameter of coralla, 16·5 × 11 mm. and 17·5 × 12 mm.

Locality. Kolumadulu, 35 *f.*, and Suvadiva, 38 *f.*, single specimens.

Only the upper third of either specimen was covered by the polyp tissues so that no further growth of the wings would have been possible. There is no trace of any epithecal tissue on either.

The two specimens differ greatly from one another in the development of their wings, which are much longer and more curved in the Suvadiva specimen. The lower parts of both were evidently imbedded in fine sand or mud so that their coralla extended horizontally. The Kolumadulu specimen has 58 septa, 12 small and 17 large pali, while the Suvadiva one, which is altogether of a more delicate appearance, has 67 septa, with a corresponding number of pali. Each specimen has over 50 rods forming its columella. The scar of attachment in each is about 3·5 × 3 mm. in diameter, filled in by deposited (?) lime and in the stage of 14—16 septa.

The species, which differs markedly from the other recent forms of the genus, I have called after the friend who assisted me in all my work in the Maldives.

Genus *Heterocyathus.*

4. Heterocyathus aequicostatus Ed. and H.

Ed. and H., II. 51, and Gard., *Marine Investigations in S. Africa*, vol. III. pp. 104—112, Plate III. (1904).

Three specimens from Suvadiva, 20—40 *f.*, were absolutely identical in every respect with the forms which I examined from the Cape Colony (*vide supra*).

Genus *Paracyathus*.

5. Paracyathus parvulus Gard. *Willey's Results*, p. 165, pl. XIX. figs. 4*a*, 4*b* (1899).

The specimens closely resemble the types save that their calices tend to be rather larger (up to 5·5 mm. in diameter) and rounder, the difference in the two diameters being generally not more than ·5 mm. The fourth cycle of septa in all is incomplete, and in the largest specimens represented by about 12 instead of 24 septa. Two specimens from Goidu show deep down in the calice a tendency towards the fusion of the quaternary septa by their sides to the tertiary, but this may take place in almost any coral; one of the same has five systems only. Occasionally specimens are found fused together at the base. They may possibly have been budded from one another, but their tissues are not in any case continuous, so that this character is probably due to chance. I append a diagram of a calice as the relationships of septa and pali to one another are not clear in the published figure (Fig. 143).

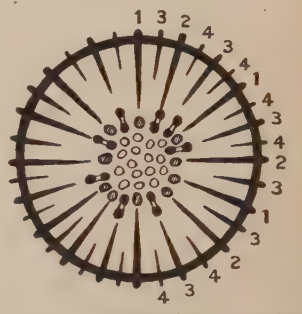


Fig. 143. *Paracyathus parvulus*. Diagram of calice to show arrangements of septa, pali and columella.

Locality. Fairly common throughout the Maldives, attached beneath any stones which may be lying free on the reef-flats outside the boulder zone.

6. Paracyathus lifuensis Gard. *Willey's Results*, p. 164, Pl. XIX. figs. 5*a*, 5*b* (1899).

I refer a number of specimens to this species, all of which differ from the type in being much smaller, the average size of the calice being about 6 by 5·5 mm. In all the *septa* are nearly equally exsert, the difference between the orders being very slight. The *pali* lie before the septa of cycles I., II. and III.; they are often bilobed before septa of cycles I. and II. as well as III., but not so regular as in the type. The sides of the specimens are much overgrown by other organisms, and there is often an epithecal deposit almost up to the mouth of the calice.

Locality. Fairly common under stones of the boulder zone throughout the Maldives and from rocky bottoms (3, S. Mahlos, 20 fathoms; 2, Suvadiva, 40 *f.*, and 1 from 31 *f.*; 1, Kolumadulu, 22 *f.*). The dredged specimens are generally smaller than those from the reef, and consequently tend to be more imperfect in their pali and septa.

EXPLANATION OF PLATES LXXXIX—XCIII.

PLATE LXXXIX.

Fig. 1. Siderastrea maldivensis, flattened top of a branch. × 2.

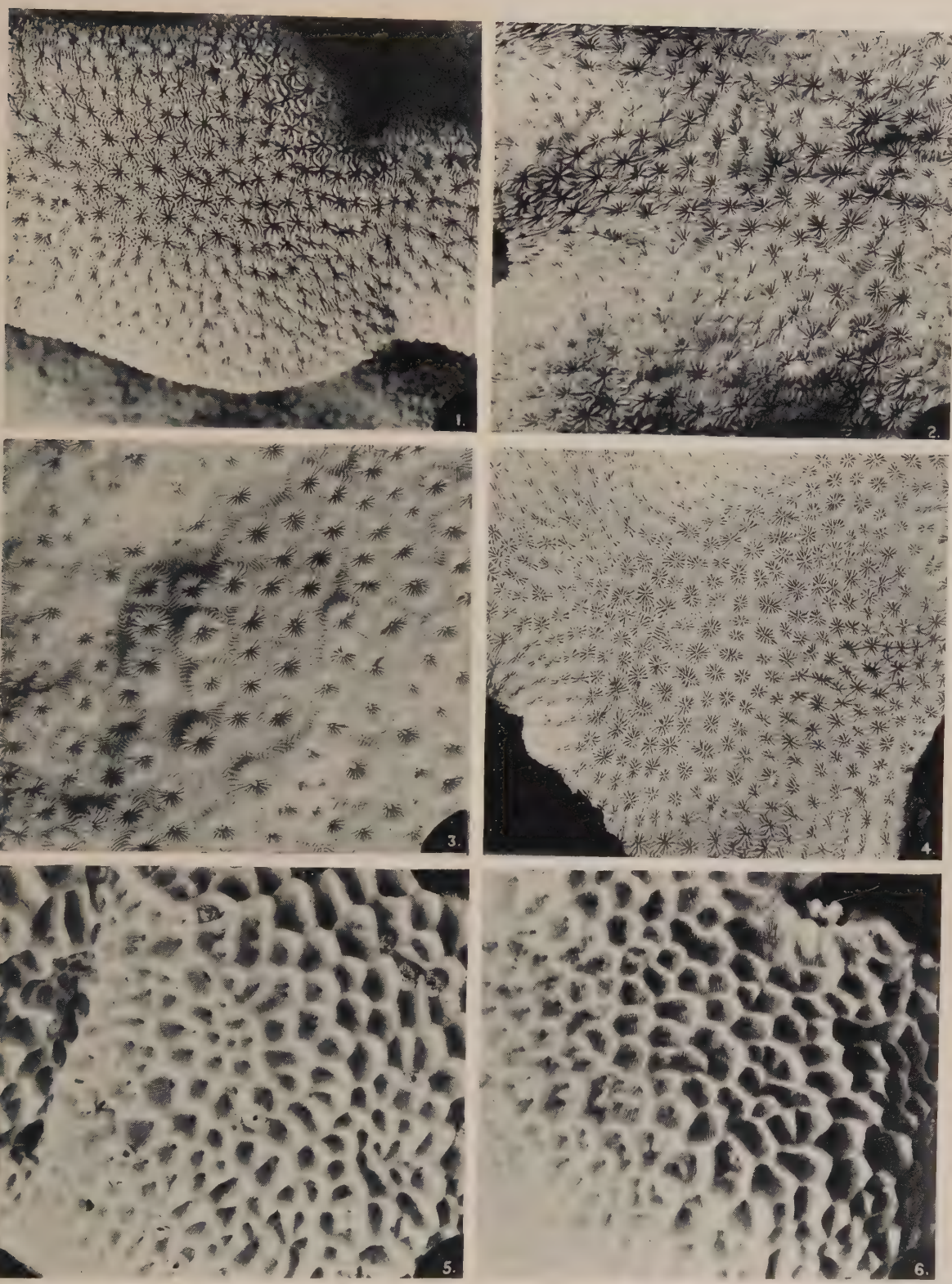
Fig. 2. „ „ side of a branch. × 2.

Fig. 3. „ „ spreading base of a colony. × 2.

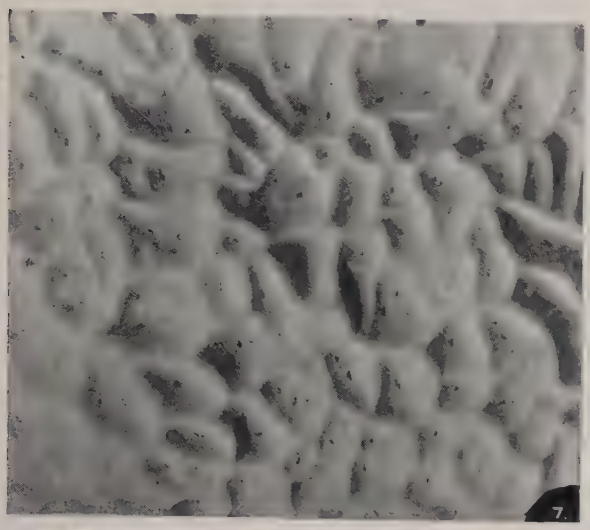
Fig. 4. „ sphaeroidalis. × 2.

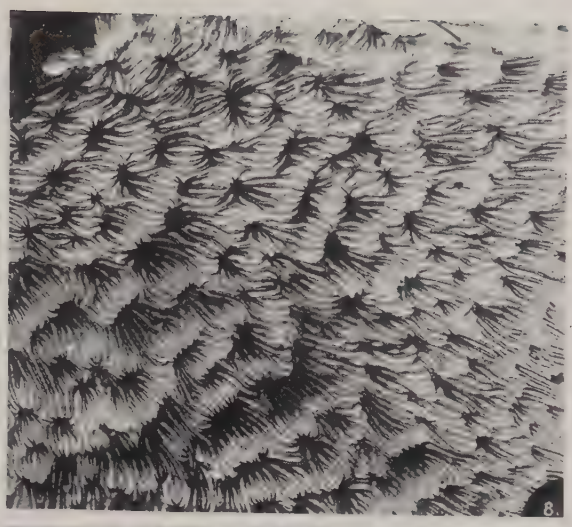
Fig. 5. Agaricia ponderosa. × 1½.

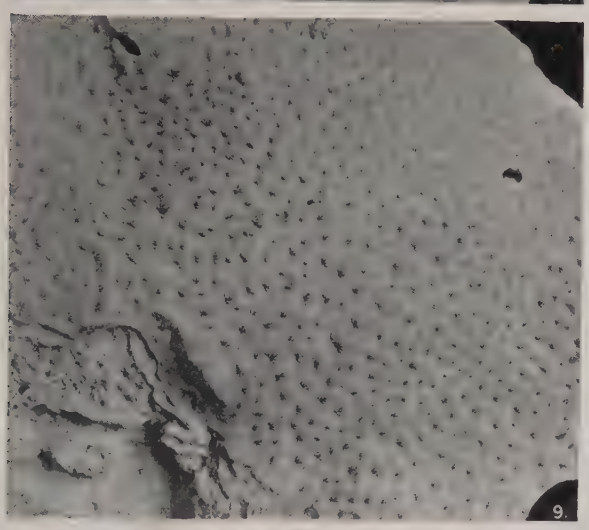
Fig. 6. „ „ × 1½.



STANLEY GARDINER——FUNGIDA (I).







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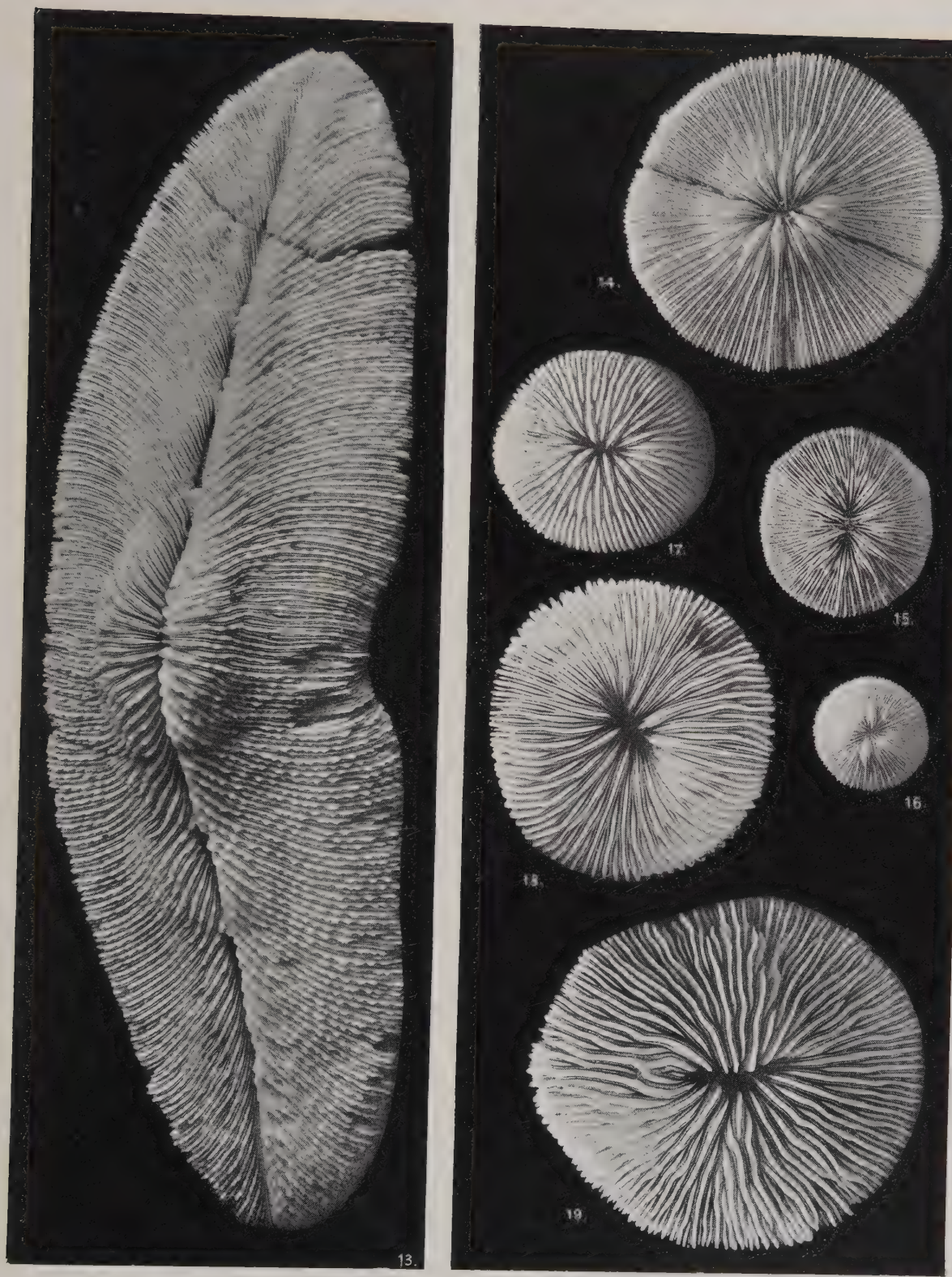

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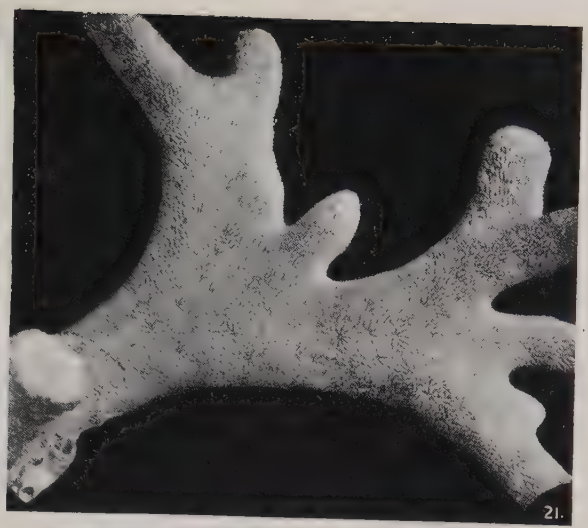

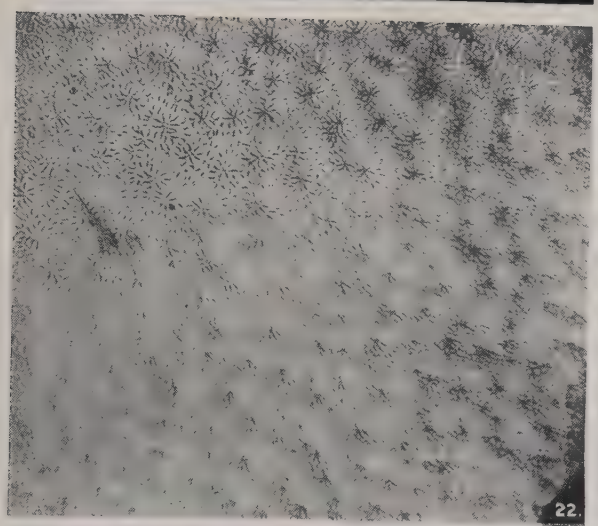

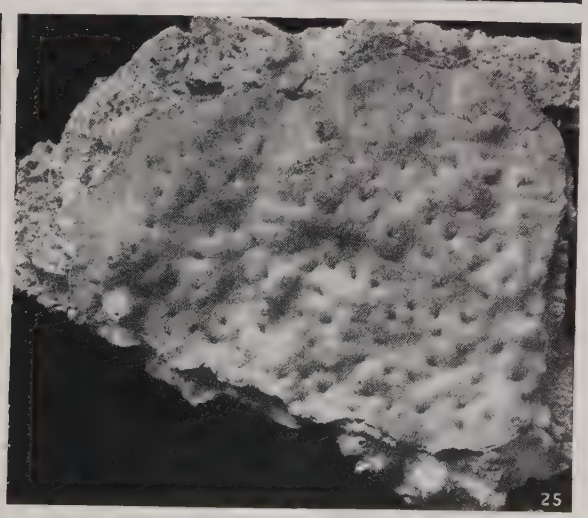

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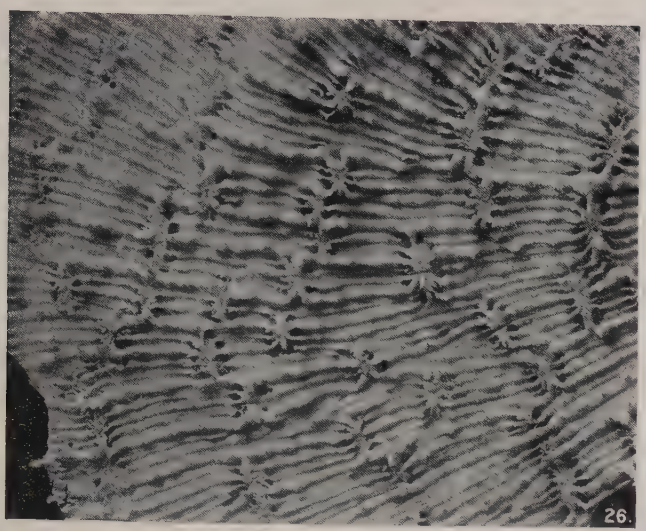

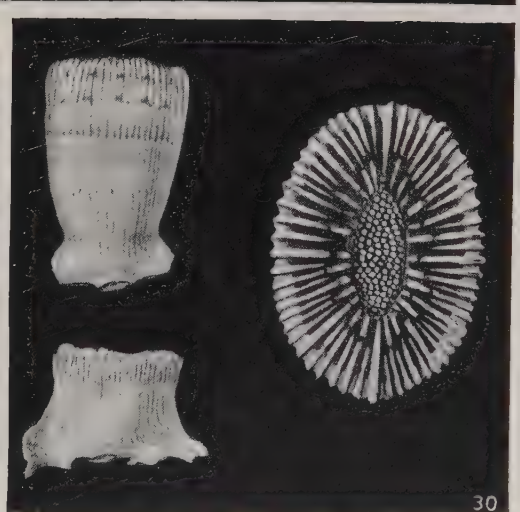

STANLEY GARDINER—FUNGIDA (V) AND TURBINOLIDAE.

PLATE XC.

FIG. 7. Agaricia ponderosa, var. minikoiensis. × $1\frac{1}{2}$.

FIG. 8. Podabacia crustacea. × 1.

FIG. 9. Pavonia repens, under surface of a colony. × 1.

FIG. 10. Pavonia repens, upper surface of a colony. × 1.

FIG. 11. „ „ meandering growth. × 1.

FIG. 12. Coscinaraea donnani. × 1.

PLATE XCI.

FIG. 13. Herpolitha simplex. × $\frac{5}{6}$.

FIGS. 14, 15, 16. Cycloseris sinensis. × 1.

FIGS. 17, 18, 19. „ cyclolites. × 1.

PLATE XCII.

FIG. 20. Psammocora divaricata. × 1.

FIG. 21. „ „ × 2.

FIG. 22. „ exesa. × 2.

FIG. 23. Leptoseris papyracea. × 1.

FIG. 24. „ fragilis. × 1.

FIG. 25. „ incrustans. × 1.

PLATE XCIII.

FIG. 26. Echinophyllia lacera. × 1.

FIG. 27. Psammoseris rousseaui. × $1\frac{1}{2}$.

FIG. 28. Flabellum multifore. × 1. Oral aspect of the largest corallum.

FIG. 29. „ „ × 1. Side-view of a smaller corallum.

FIG. 30. Tropidocyathus cooperi. Side-views (drawings) of the two coralla (× 1) and magnified drawing of the oral aspect of the taller corallum.

SCYPHOMEDUSAE.

By Edward T. Browne, B.A., *Zoological Research Laboratory, University College, London.*

(With Plate XCIV.)

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Pelagia sp.

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Aurelia solida, species nova.

Rhizostomata 962

Cassiopea andromeda (Forskål), var. nov. *maldivensis.*

Netrostoma coerulescens Maas.

INTRODUCTION.

The few Scyphomedusae collected by Mr Stanley Gardiner have given me the opportunity of examining medusae belonging to a group upon which I have done but little practical work. I feel somewhat diffident about this report, knowing only too well how easy it is to go astray in identification, when one has only preserved specimens to work upon and has not had the great advantage of seeing some of them alive. The labour, however, has been considerably lessened by the Report on the Scyphomedusae of the *Siboga* Expedition, recently written by Maas (1903), as it contains not merely descriptions of species but useful criticisms. Three species in the Maldive collection are identical or very closely related to species found by the *Siboga* Expedition in the East Indies.

In April, 1903, Bigelow published a Report upon the Medusae collected by Professor Agassiz's Expedition to the Maldive Islands. A fair number of Hydromedusae were found, but only two Scyphomedusae, namely, *Nausithoe punctata*, which has a wide geographical range, and *Aurelia maldivensis*, which is described as a new species, and was found in shoals in Suvadiva and other atolls. Neither of these species occurs in Mr Gardiner's collection.

I have described one new species—*Aurelia solida*. Its specific character is mainly based upon the structure of the sense organs and the shape of the subgenital cavities. I have also described a new variety of *Cassiopea andromeda*. The finding of a *Cassiopea* in the Maldives furnishes an important link in the geographical distribution of the species. The Maldive specimens are closely related to *Cassiopea* found in Jamaica and the East Indies.

SEMAEOSTOMATA.

Pelagia sp.

About 50 specimens of a young *Pelagia* were taken at Minikoi on August 3, 1899. They are all about the same age and are a little older than the Ephyra stage.

The umbrella is about 5 to 8 mm. in diameter. There are small circular clusters of nematocysts scattered over the ex-umbrella, the marginal lobes and the oral arms. Sixteen broad marginal lobes with rounded corners. Eight tentacles. Eight sense organs. There are 10 to 12 gastric filaments in each of the four groups. The oral arms are little longer than the radius of the umbrella. The gonads have not yet begun to develop.

Aurelia aurita var. *colpota*, Brandt, ex Maas, 1903.

Aurelia aurita var. *colpota*, Maas (1903, p. 26, Taf. I. fig. 9).

The collection contains four small immature specimens. The smallest measures about 15 mm. in diameter and the largest 40 mm.

I have compared the largest specimen with *Aurelia aurita* of similar size taken at Plymouth. The Maldive specimen is at a much earlier stage in development. It is without gonads, and the subgenital cavities are just beginning to form. The ocular canals have only a few branches. The Plymouth specimen has conspicuous genital bands with immature ova, and the subgenital cavities have nearly completed their development. The ocular canals have many more branches.

In the Maldive specimen the radial canals are narrower and have a more slender appearance than those in the Plymouth specimen, and in general appearance they resemble Maas's figure (Taf. I. fig. 9) of *Aurelia aurita*, var. *colpota*. The ocular canals have fewer branches as the specimen is quite young, whereas Maas's figure is that of an adult.

The tentacles on the margin of the umbrella have transverse rings or bands of nematocysts, and the arrangement of the bands is similar in both the Maldive and the Plymouth specimens. In the Maldive specimen the bands are about half as thick and broad, so that the tentacles have a smoother appearance than those of the Plymouth specimen.

As the specimens are immature, the difficulty of correctly determining the species or variety to which they belong is increased. I think that I shall not be far wrong in regarding them as young stages of *Aurelia aurita*, var. *colpota*, especially as *Aurelia colpota*, Brandt was first found in the Indian Ocean.

Aurelia solida, species nova. (Pl. XCIV. figs. 1, 2.)

There is only one specimen in the collection. It is in a good state of preservation, but slightly damaged on the margin of the umbrella and in the oral arms.

I have carefully compared this specimen with *Aurelia aurita* taken at Plymouth, and have come to the conclusion that it is specifically distinct from it. It possesses certain well-marked characters, which, taken together, remove it beyond the range of being a variety, and as I have not found these characters in any other described species of the genus I propose to describe it as a new species. The *tentaculocysts* lie at right angles to the position they occupy in *Aurelia aurita*, and their change of position has modified the structure of the sense organ. The subgenital cavities are large, with very thick walls and very small circular openings. Their shape is unlike that of the subgenital cavities of the other species of the genus. The medusa has a very firm and solid appearance, hence the specific name.

Description. The umbrella is hemispherical, about twice as broad as high, with thick walls. The thickness of the jelly above the stomach is equal to about half the height of the umbrella. The ex-umbrella is closely covered with small circular clusters of nematocysts. The clusters form minute warts over the surface of the ex-umbrella, but are not so large as those on the ex-umbrella of *Aurelia aurita*.

Oral Arms. The four oral arms (only one is perfect in the specimen and it measures, from the centre of the mouth to the distal end, about 60 mm.) are like thin narrow ribbands, but not very flexible. The oral margins of the arms are slightly folded on the inner half and almost straight along the distal half. Along the margins there is a row of short, stumpy tentacles. The four arms meet in the centre to form the cross-shaped mouth, which is supported by very thick walls. The oral walls have a solid, massive appearance. They hang down about 20 mm. below the subgenital cavities, and measure, interradially, about 20 mm. across.

Radial Canals. The mode of branching of the interradial canals has been used as a specific character, but I think it of little value as both development and variation effect great changes. In *Aurelia aurita*, at a very early stage, in each perradius and interradius there is an unbranched canal which goes direct from the stomach to a sense organ. A little later on these canals have two opposite lateral branches, and the branching occurs close to the stomach. The two first branches again branch, and every branch, which is formed, again branches. The number of branches, which finally exist, depends upon the size of the umbrella. As the periphery of the umbrella increases in size, the branches increase in number. As a rule in the perradii the branched canals retain their original pattern, and simply increase the number of branches towards the margin, but in the interradii a change occurs, which alters the appearance of the canal pattern. One frequently finds a single unbranched interradial canal running straight from the stomach to the sense organ and on each side of it a branched canal, the original main canal having become isolated from its branches. This separation is due to the outgrowth of the stomach, along with the subgenital cavity. The stomach in its outward growth takes in and cuts off the main canal below its first pair of branches. Sometimes the outgrowth of the stomach not only cuts off the first pair of branches, but also the second pair. Then one sees two branched canals on each side of the main canal. Occasionally two branched canals occur on one side of the main canal and only

one on the other side. This arises when the branches on the opposite sides of the main canal do not start in the same zone, but at unequal distances from the stomach.

In the Maldive specimen the interradial canals are irregular. Two interradii have a main canal and two pairs of isolated branched canals. One interradius has two isolated branched canals on one side of the main canal, but only one branched canal on the other. The fourth interradial canal has a complicated pattern which is due to regeneration after an injury.

Anastomosing of the canals is a secondary matter. It may occur in some individuals, but not in others, or in one or more quadrants, but not in all. I noticed in the Plymouth race of *Aurelia aurita* that some individuals have a well-marked anastomosing of the canals, whereas others of similar size (all adults with planulae) had scarcely a trace of anastomosis. In the Maldive specimen, in one part of the umbrella, anastomosis is conspicuous, but on the greater portion of the umbrella it occurs just here and there, and very close to the margin.

Owing to the thickness of the walls of the subgenital cavities, the adradial and interradial canals pass across and above the subgenital walls to reach the stomach which has its periphery just outside the genital bands.

Sense Organs. The sense organs are set back much further from the margin of the umbrella than in *Aurelia aurita*. The tentaculocyst is situated at the end of a deep groove (Pl. XCIV. fig. 2), which is open on the dorsal side and bordered by the lateral lappets, but closed on the ventral side. This groove is not present in *Aurelia aurita*.

In *Aurelia aurita* the tentaculocyst points towards the margin of the umbrella and is protected dorsally by a hood.

In *Aurelia solida* the tentaculocyst points towards the ex-umbrella, its position is at right angles to the position of the tentaculocyst in *Aurelia aurita*.

The wall at the upper end of the groove has a slight concavity and a little projecting ridge or overhanging ledge along the dorsal margin, forming a protecting cavity for the tentaculocyst. This appears to me to represent the dorsal hood in *Aurelia aurita*.

The dorsal sensory pit is large and runs down to the base of the tentaculocyst. It is a deep triangular funnel, with a long narrow mouth; it is not at all like the shallow dorsal pit present in *Aurelia aurita*.

The ventral sensory pit is situated in the floor of the groove, just below the base of the tentaculocyst. It is very small and not so definite or so conspicuous as the ventral pit in *Aurelia aurita*.

The search for an ocellus on the tentaculocyst has not proved satisfactory. I failed to find a definite pigment spot, but it is quite likely that the colour of the ocellus has dissolved away in the formalin.

The sense organs of *Aurelia solida* are like those in *Aurelia aurita*, except that there is a change in position. The sense organ has moved back further from the margin and lies in a deep groove. The tentaculocyst and its hood have turned round in a dorsal direction about 90 degrees, and this has affected the position and shape of the dorsal sensory pit.

Tentacles. The tentacles have a much smoother appearance than those of *Aurelia aurita*, owing to the transverse bands of nematocysts being narrower and thinner. The velaria and dorsal lappets are similar to those in *Aurelia aurita*.

Subgenital Cavities. The subgenital cavities are very conspicuous on account of their shape, size, and solid appearance. They look like four balls attached to the surface of the subumbrella. They measure about 15 mm. in width and 10 mm. in height, and have a thick and firm external wall. The lateral wall of cavity is about 4 mm. in thickness and the lower wall is also very thick. The wall of the cavity feels firm and solid, even round the ostium, and does not yield when pressed upon. The ostia only measure 2 mm. in diameter, and are circular in shape. They are simply circular openings and have not a funnel-shaped appearance as in *Aurelia aurita.*

Gonads. The four gonads form circular bands which measure about 12 mm. in diameter, and are more circular in shape than those in *Aurelia aurita.*

Size and Colour. Umbrella about 80 mm. in width and 40 mm. in height. The natural colours have not been recorded, but in formalin the specimen has a translucent whitish appearance, with gonads of a pale salmon colour.

RHIZOSTOMATA.

Cassiopea andromeda (Forskål) nov. var. *maldivensis.*

The collection contains 14 specimens, which are at different stages in growth. The smallest measures 15 mm. in diameter and the largest about 75 mm. They were found at Felidu.

Description. The umbrella is disc-shaped, moderately thick, with a large shallow concavity on the aboral side. Around the periphery of the aboral cavity there is a narrow, slightly raised, circular band, which is situated near the margin of the umbrella. This circular band is finely wrinkled, in a radial direction, and is bounded on the inner and outer margins by a line-like groove. A few of the specimens show a slightly raised dome in the centre of the concavity, but others have the aboral side of the umbrella almost flat. This medusa has the habit of lying on its back, which habit exists in other species of the genus. Mr Stanley Gardiner in a letter to me writes: "Sometimes they may be found lying upon their backs, but generally they seem to almost float with the end half or quarter inches of their arms on the bottom. Where there is a little tidal ripple, they almost appear to be moving with their arms as motile appendages, at the same time contracting their bell slowly. Their favourite position is in the backwaters, covered with relatively dark mud, with decaying leaves and other organic matter, and with only a few inches of water at low tide. These often after heavy rain become decidedly brackish, but without injury to the medusae."

The presence of a circular band upon the ex-umbrella and also that of a concavity suggest a resemblance to the "Suction cup" described by Keller (1883) in *Cassiopea polypoides* and by Bigelow (1900) in *Cassiopea xamachana.* Bigelow states that "the concavity of the ex-umbrella is an important aid in maintaining this posture (lying on its back) against the action of waves and currents. The gelatinous tissue is firm and elastic, and causes the umbrella to assume its normal shape when the sub-umbrellar muscles are relaxed. The slight suction thus produced when the medusa comes to rest on a flat surface gives it such a hold that a certain amount of force is required to remove it." All the Maldive specimens have the circular band upon the ex-umbrella and it probably acts as a pad in connection with the working of a suction cup.

Marginal Lobes. The lobes on the margin of the umbrella show a variation both in number and in shape. In a few specimens the velar lobes are properly formed and isolated from each other, but in many of the specimens the velar lobes are more or less joined together and are often joined to the ocular lobes, forming either a slightly undulating or a straight margin between the inlets of the tentaculocysts. Maas (1903, Taf. IV.) has given six figures of the marginal lobes of *Cassiopea ornata* var. *digitata* and *Cassiopea andromeda* var. *malayensis*, and states the number of lobes to be useless for a specific character as the number increases with age. In the smallest specimen I find about two velar lobes between every two ocular lobes. Several specimens (umbrella 30—40 mm. in diameter) have three velar lobes in each paramere, and in the largest specimen the number increases to about 7 to 10, perhaps more. The number is not constant in each paramere, and owing to the even margin between the ocular inlets it is not easy to make out the lobes or to be sure of their number.

Sense Organs. These are normally sixteen in number, but several specimens have either more or fewer than the normal number. Ten perfect specimens were examined; four had 16 sense organs, two had 15, one had 19, two had 14, and one had 12. The sense organs are not always situated at equal distances apart and occasionally are adjacent without any velar lobes in between. Bigelow counted the sense organs of *Cassiopea xamachana* and found that only 10 specimens out of 27 had the normal number.

Canal System. There are normally 32 radial canals, sixteen in the radii of the sense organs and the others alternate between them. These main canals are joined together along their whole length by a network of anastomosing branches. The network becomes coarser and the canals broader towards the margin. I could not make out a definite circular canal. There is apparently a correlation between the number of radial canals and the number of sense organs. A correlation exists between the number of radial canals and sense organs in *Aurelia aurita*.

The canal system on the oral disc is similar to that in the figure given by Haeckel for *Cassiopea depressa*.

Gonads. The position and shape of the gonads resemble those in the figures given by Bigelow and Maas. The four subgenital apertures are very small, triangular in shape, about 1—2 mm. in width in the smaller specimens and about 3 mm. in the large ones.

Subumbrella Muscles. The muscles on the subumbrella are similar in form and pattern to those described in the other species of the genus, forming a circular series of undulations (figured by Maas 1903, Taf. IV. fig. 30).

Oral Arms. The eight oral arms are arranged in pairs, and extend a little way beyond the margin of the umbrella. In several specimens the arms are in a contracted condition and lie well within the margin.

The branches of the oral arms are arranged in an alternating series with a tendency towards dichotomous branching near the distal ends. There are generally about three long branches and 2 to 6 shorter ones. The branches also bear an alternating series of shorter branches. The branching is always lateral and in the same plane, so that the oral arms have a flattened appearance, and the eight arms cover up nearly the whole umbrella when the medusa is lying on its back. The main trunk of the arm is either triangular in section or laterally compressed. The arms are similar to those of the type figured by Maas for *Cassiopea andromeda* var. *malayensis*, but the main trunk is more slender.

One specimen has seven oral arms and one has four arms. The latter is a large specimen (75 mm. in diameter) and its four arms have extra long lateral branches, the longest about half the length of the arm. The covering area of the four arms is nearly equal to the area occupied by eight arms.

Oral and Brachial Appendages. In the smallest specimens the brachial appendages are about 1 to 2 mm. in length and are situated in the axil of every branch or adjacent to an osculum. They look like leaf-shaped discs upon a short stalk and are covered externally with numerous little tubercles bearing nematocysts. In the larger specimens these appendages are about 3 to 4 mm. in length. The disc is variable in shape, but usually roundish or spatulate; the stalk is cylindrical, its length is about equal to the diameter of its disc. A canal, in connection with the brachial canal system, runs up the centre of the stalk and broadens out inside the disc, so that it is simply a hollow, flattened vesicle with moderately thick walls.

At an early stage the disc has only one kind of tubercle with nematocysts, but later on a second kind of tubercle appears. These tubercles are papilliform in shape and are situated in a circular depression on one side of the disc, rarely on both sides. Each tubercle has several little knobs armed with minute nematocysts.

The disc-shaped appendages are present in all the specimens and usually one is adjacent to an osculum. In the larger specimens there are other appendages which are produced by a further development of the disc-shaped form. These may be separated into two types, namely, band-shaped and cylindrical. The cylindrical type measures up to 22 mm. in length and 3 mm. in width, and tapers off to a blunt point at the distal end. The appendages belonging to this type are always long and slender; cylindrical at the base and frequently slightly bilaterally compressed along the distal half of their length. The band-shaped appendages are more like broad, flat leaves, with a rounded or tapering distal end, measuring up to 25 mm. in length and 9 mm. in width. A canal runs along the whole length of the cylindrical appendages, and its shape follows closely the external shape of the appendage. But in the band-shaped appendages the canal either becomes a flat hollow sac or forms a coarse network. There is a great variation in the width and length of the large appendages and it is quite easy to make up a series connecting the extremes of the two types.

The two kinds of tubercles found upon the exterior of the little disc-shaped appendages are present in both types of the large appendages. The papilliform tubercles are usually few in number and irregularly arranged at the distal end of the large appendages.

Many of the appendages have an opening to the exterior and the opening looks like a mouth. It is, however, very irregular in shape and position and in many cases the opening is certainly the result of an injury. After carefully examining many appendages I came to the conclusion that the internal cavity is a blind sac and that the appendages are without a mouth or any natural opening to the exterior.

Both the thin band-shaped and the long cylindrical appendages are found in the same individual. Their position on the arms is by no means constant and apparently any one of the small disc-shaped forms is capable of developing into either type of the large appendages. They are not numerous on the arms in any of the specimens. Their number is variable, but not more than five or six are found on one arm. All the specimens (except one) have the largest appendage in the centre of the oral disc and it may belong to either type. One specimen has the central appendage bifurcated. Only one large specimen shows the formation

of numerous additional appendages within the oral disc. The oscula are closing up and new appendages are being formed in their place.

Colour. The specimens are of greenish colour which is entirely due to "green cells." The oscula and brachial appendages are of a dark greenish colour, the umbrella of a pale green. The specimens look just as if they had been stained with an aniline dye. A few of the largest band-shaped appendages have a trace of reddish purple colour. The green colour is gradually fading away in formalin, and the specimens which have been exposed to light are paler than those which have been kept in the dark. Five small specimens in one bottle have lost all traces of colour and the green cells have become whitish. There is not the slightest trace of any coloured patterns or markings upon the umbrella, such as have been figured and described for other species of *Cassiopea*. I wrote to Mr Gardiner about the colour of these specimens and he replied, "I remember the medusae you refer to quite well. In their natural condition they are dark green without any spots or other markings upon them."

Green Cells. Bigelow has demonstrated by chemical tests that the green cells in *Cassiopea xamachana* are unicellular plants containing starch and a form of chlorophyll inside a cellulose wall. He considers that there is a symbiotic relationship between the algae and the medusa, the former supplying the medusa with oxygen, and that "their presence undoubtedly enables the medusae to live in water that would be too poor in oxygen for most marine animals." The absence of a sufficient supply of oxygen in the shallow pools and lagoons, I think, has yet to be proved, especially as Bigelow found copepods and other small crustacea in the stomach of *Cassiopea*. Gardiner clearly states that the Maldive *Cassiopea* lives in tidal waters, and in places where the tide flows there is not likely to be a deficiency of oxygen. I am inclined to the view that these unicellular algae are parasitic and that it is not a true case of symbiosis. Other species of *Cassiopea* have green cells, but some have been described without them. Agassiz and Mayer (1898) state that "the colour of *Crambessa mosaica* is normally cobalt blue, but a species of Zooxanthella commonly infests it, forming dense clusters through the jelly, and when this is the case the blue colour is lost and the medusa changes to a brown colour." On the Australian coast in certain localities the blue form occurs, and in others the brown one. In this case the same species is found with and without the Zooxanthella, clearly showing that the medusa can live perfectly well without the aid of the alga.

In the Maldive specimens the green cells are either isolated or grouped into little clusters varying in size and shape. A cluster may contain only a few cells or any number up to a hundred or more. The cells are situated in the mesoglaea, just below the ectoderm. They are densely crowded together in the walls of the oscula, and form larger clusters on the lower side of the trunk and branches of the arms than on the upper side, and still smaller clusters on the subumbrella and ex-umbrella. A cluster of green cells is usually present in the tubercles on the brachial and oral appendages. The green cells are densest in the parts which are nearest to the light when the medusa is lying on its back. A green cell is about 0·02 mm. in diameter, circular in shape and contains a nucleus, a refractive body, and many green chromatophores. The test with iodine and sulphuric acid failed (in my hands) to prove the existence of a cellulose wall.

The green cells or Zooxanthellae found in *Cassiopea xamachana* have a greenish brown colour and apparently the colour is not removed by alcohol. The green cells in the Maldive specimens are of a pure green colour, and the chlorophyll is quickly removed by alcohol.

The genus *Cassiopea* at the present time consists of about 12 species and varieties. It appears that whenever a *Cassiopea* is found in a new locality, it is almost certain to be described either as a new species or a new variety. It is evident from the publications of Keller, Bigelow and Maas, that *Cassiopeae* found in localities far apart show a considerable amount of variation. The organs which are especially subject to variation are the organs which have been selected for specific characters. Until we know definitely the range of variation in one or two local forms we are not likely to correctly determine the species, for the simple reason that we do not at present know upon what to base the specific characters. A few specimens, about 20 or 30, are not a sufficient number for the study of the variation in a *Cassiopea*. To judge from Bigelow's account of the variability of *Cassiopea xamachana* several hundred specimens would be required and probably a biometrician would fix the minimum number at a thousand. In the Maldive collection there are only 14 specimens, several of which are imperfect, and about half are small and immature. For this reason I have not tabulated the variations, but the specimens appear to be quite as variable as *Cassiopea xamachana*.

The number of lobes upon the margin of the umbrella has been used for a specific character. Maas is right in saying that this is useless for a specific character as the number increases with age, a coalescing occurs which makes counting uncertain, and also the number in each paramere is by no means constant.

The length of the oral arms has been included among the specific characters, but I think it is of little value. The arms are not firm and rigid, but are mainly composed of jelly and are contractile. Some of my preserved specimens have the arms contracted and these lie well within the periphery of the umbrella, others have them expanded beyond the margin of the umbrella.

The coloured markings or patterns on the umbrella have been taken for a specific character. It has been shown by Keller and Bigelow that the colour and patterns are very variable. These markings are present in all the species with the exception of *Cassiopea depressa* and *Cassiopea andromeda* var. *malayensis*, and they are also absent in the Maldive specimens. Maas considers that the absence of coloured markings in *C. depressa* and *C. malayensis* may be due to preservation; but with regard to the Maldive specimens Mr Gardiner has informed me that coloured markings were absent in the living specimens.

The mode of branching of the oral arms has also proved to be variable, and when the full extent of their variation is known, we may be able to form definite types. There is a well marked difference between the branching of the arms in *C. digitata* and that in *C. malayensis*.

Great use has been made of the appendages upon the oral arms for distinguishing one species from another. Some are described with only small appendages. Some with large appendages, and others with both large and small appendages. The Maldive specimens show that the early stages have only the small appendages, but later on some of these small appendages develop into large ones, which vary very much in shape, number and position.

Two species (*C. polypoides* and *C. xamachana*) have been described with a suction cup on the ex-umbrella. Keller's beautiful figure of *C. polypoides* shows a most conspicuous suction cup, but in *C. xamachana* it is apparently a shallow cup ("A *Cassiopea* with a disc-like umbrella, concave on the aboral side"). If it had not been for the presence of

the circular band on the ex-umbrella of the Maldive specimens, I should have regarded the concavity as the result of preservation, especially as it is not present in all the specimens.

I do not think that the Maldive *Cassiopea* is a new species, and I am somewhat doubtful as to whether or no it can be permanently established as a new variety. It is closely related to *C. xamachana* found at Jamaica, but differs from it in not possessing any coloured markings on the umbrella. *C. xamachana* is closely related to *C. polypoides* from the Red sea.

The Maldive specimens are also closely related to *C. andromeda* var. *malayensis*, but they differ from it mainly in the possession of a circular band upon the ex-umbrella; the other differences would probably come within the range of variation.

I think it is best to refer the Maldive specimens to *Cassiopea andromeda* (Forskål) which is the oldest species known and an inhabitant of the Red Sea, and to establish a new variety called after the locality.

It is my opinion that when we know more about *Cassiopea* there will be a further reduction in the number of species and the establishment of a number of varieties. *Cassiopea* belongs to the littoral fauna and its habitat favours the formation of local races or varieties.

Netrostoma coerulescens Maas, 1903.

Netrostoma coerulescens, Maas (1903, p. 35, Taf. v. figs. 37—46, Taf. xi. figs. 97 and 103, Taf. xii. fig. 109).

The genus *Netrostoma* was established by L. S. Schultze in 1898 for *Netrostoma typhlodendrium* found near Amboina Island in the East Indies. Maas in 1903 described another species, *Netrostoma coerulescens* found by the *Siboga* Expedition at Amboina, Sanguisiapo, and south of the Celebes. Maas has also amplified the generic characters and includes within the genus, *Halipetasus scaber*, Schultze (1898) found at Amboina, *Cephea dumokuroa*, Agassiz and Mayer (1899) from the Fiji Islands, and is uncertain about *Microstylus setouchianus*, Kishinouye (1902) found on the coast of Japan.

Netrostoma typhlodendrium has the four subgenital cavities isolated from each other. This isolation of the subgenital cavities led Kishinouye to establish the genus *Microstylus* for *M. setouchianus*, which has a single four-lobed subgenital cavity. Kishinouye has clearly described and figured the subgenital cavity and I have found an exactly similar cavity in the Maldive *Netrostoma*. Maas states that the young specimens of *Netrostoma coerulescens* have isolated subgenital cavities, but later on a coalescence takes place. The Maldive specimens are certainly closely related to *Microstylus setouchianus*, and the only main difference which I can see is in the shape of the crown on the top of the umbrella. Unfortunately my best and largest specimen has a damaged crown, but what is left of it shows no indication of the large cluster of apical tubercles as figured by Kishinouye. I think that *Microstylus setouchianus* should be included in the genus *Netrostoma*.

The description given by Agassiz and Mayer of *Cephea dumokuroa* is not so complete as it should be, consequently Vanhöffen (1902) regards the species as belonging to the genus *Cephea*, but Maas considers it to be a *Netrostoma*. In the description there is no mention of the oral appendages, which are important, and the figures do not show any. If it be

a *Cephea* one would expect to see the long whip-like filaments on the oral arms, but as these are not figured Maas is probably right in regarding it as a *Netrostoma*.

Netrostoma scabrum differs from the other species in having the oral arms compressed dorso-ventrally, instead of laterally. The specimen described by Schultze was probably an immature specimen (about 60 mm. in diameter). The umbrella is without a crown or large apical tubercles, but has some widely scattered granules or warts which can be felt on the otherwise smooth surface of the ex-umbrella. The immature Maldive specimens are without a crown and have a few minute warts as described by Schultze.

My determination of the species of the Maldive specimens is not so certain as I should like it to be. This is due partly to the destruction of the natural colours by preservation and partly to the fact that the gelatinous crown in the largest specimen is badly damaged. I have failed to find any character sufficiently definite for the establishment of a new species or variety. As the specimens resemble *Netrostoma coerulescens* more closely than the other species I consider it best to associate them with this species.

Description of the Maldive specimens.

Umbrella. All the specimens have the umbrella badly folded, and out of shape. In the largest specimen there is a distinct gelatinous thickening upon the top of the umbrella forming a kind of cap with lateral lobes. It is impossible to make out its full shape as it is partly damaged, but it is probably similar to the cap on the umbrella of *Netrostoma coerulescens* (Maas, 1903, Taf. v. figs. 41—42). There are no traces of the large apical tubercles which are present in the other species of the genus. The other specimens, which are much smaller, have a plain convex umbrella, without a distinct gelatinous thickening on the top. The thickness of the umbrella decreases rapidly towards the margin which is thin and flexible.

The smaller specimens have a few scattered wart-like extuberances or granules over the top of the ex-umbrella. They are very minute swellings with a brownish wrinkled apex, from which radiate a few brownish lines. They do not exceed a millimetre in diameter (the brownish spot is less than a quarter of a millimetre), and are just visible to the naked eye. The ex-umbrella of the small specimens resembles that of *Netrostoma scabrum*. In the largest specimen below the gelatinous crown there are a few little warts similar to those in the smaller specimens, and also a few circular or oval swellings, about 2 mm. in diameter. The latter are not visible when the specimen is in fluid, but can be seen when the surface of the ex-umbrella is nearly dry.

Oral Disc. The periphery of the oral disc has eight adradial lobe-like projections and into these lobes the cavities of both the subgenital cavities and the stomach extend. On the sides of the oral disc, above the subgenital ostia there are many small tubercles, forming a band which extends for a little way along the sides of the oral arms.

Radial Canals. Thirty-two radial canals leave the stomach (eight ocular and three between every two ocular). The ocular canals at about half the distance between the stomach and the margin of the umbrella, and the interocular at about a quarter of this distance, begin to send out lateral branches which form an anastomosing network. The distance from the stomach at which the anastomosing begins is not constant. In one specimen some of the ocular canals give off lateral branches about midway between the stomach and the

margin of the umbrella, but the others do so much nearer the margin, at about three-quarters of the distance from the stomach. The interocular canals begin anastomosing either quite close to the stomach or a little way from it. The specimens show that the interocular canals always begin their anastomosing closer to the stomach than the ocular canals and that the distance is not constant. The network has not a definite pattern, but there is a tendency towards small, somewhat square meshes about the middle of the subumbrella, and larger and longer meshes near the margin. The ocular canals are a little broader than the interocular canals. There is no definite circular canal.

The Margin of the Umbrella. The lobes round the margin of the umbrella are more or less damaged and completely torn away in some of the specimens. They appear to be longer and more pointed than those represented in Maas's figure (1903, Taf. XII. fig. 109) of *Netrostoma coerulescens*. In the two largest specimens there are about 7 velar lobes between every two ocular lobes, but it is impossible to be sure of the exact number in each octant. There is usually one prolongation of the canal system into each velar lobe, but often two or three into the lobes next the ocular lobes.

Sense Organs. The eight tentaculocysts are situated in deep funnel-shaped cavities and do not show an ocellus.

Subumbrella Muscles. The muscles upon the subumbrella have completely disappeared from nearly all the specimens. There are, however, traces of muscle bands running in a radial direction on one specimen.

Subgenital Cavity. The four subgenital ostia are tubular and have a circular aperture. In the largest specimen the ostia are about 8 mm. in length and 3 mm. in diameter, and in the smallest specimen about 1 mm. in length and 0·5 mm. in diameter. The four subgenital sacs are not isolated, but are in communication with one another. The cavities are separated from one another by perradial septa for about half their length. The length of the septa is variable, but they do not meet or unite in the centre in any of my specimens. The septa are thick gelatinous walls, continuous with the wall of the oral disc, and extend from the periphery of the disc towards the centre. Although each septum stops short of the centre, its upper margin is continued to the centre as a broad, isolated, gelatinous band. The four bands meet in the centre and thus form a cross. The four gastrogenital membranes are attached to the septa and to the bands, the latter forming a support for keeping the membranes suspended. They extend horizontally across the cavity inside the oral disc, and separate the gastric cavity, which is above, from the subgenital cavity which is below. The part of the gastro-genital membrane, which bears the gonads, is arranged in a series of sac-like folds, forming a horseshoe-shaped band in each quadrant. The gastric filaments are on the upper side of the membrane and extend round the outer margin of the genital bands. The subgenital cavity of these specimens is similar to the subgenital cavity of *Microstylus setouchianus*.

Oral Arms. The eight oral arms are nearly as long as the radius of the umbrella, very much laterally compressed, and curved upwards at the distal end. Each arm, about half way from its base, divides dichotomously, and the two branches thus produced are about half the length of the whole arm, or a little less than this. There are many very short lateral branches upon both sides of the main stem and its two principal branches, and these are arranged in an alternating series. The canals which run to these branches from the main brachial canals are also arranged in an alternating series. I am inclined to the view

that the shape of a lateral branch when fully developed is a facsimile of an oral arm, that it is once dichotomously divided, and its stem and the two principal branches have lateral mouths or miniature branches with two or more mouths, arranged in an alternating series. A lateral mouth is the origin of a lateral arm. I am not sure, however, about the dichotomous division. A few of the lateral branches seem to be so divided, and many do not, but most likely the latter have not reached the stage in development at which division takes place. The general appearance of the oral arms is similar to that in *Netrostoma coerulescens* (Maas, 1903, Taf. v.).

Oral and Brachial Appendages. The oral disc is well supplied with appendages in different stages of development. The largest are situated at the junction of the oral canals and the smallest next the brachial mouths. The large appendages, about 6—10 mm. in length, have a thick gelatinous appearance, tapering off distally to a blunt point. The base of an appendage is distinctly triangular, but the appendage itself is either oval or slightly triangular in a transverse section. A slender canal, in direct communication with the oral canal system, runs along the centre of an appendage up to the distal end, where there is a minute orifice. Around the distal end of all the appendages there are many external papilliform tubercles. These tubercles are on very short stalks, almost sessile, and have several clusters of nematocysts. In addition to these papilliform tubercles there are other slight swellings sparsely scattered over the appendages and these also contain nematocysts. The small appendages on the oral disc belong to the same type as the large appendages and have the same kind of tubercles with nematocysts. They are about half, or less than half, the size of the large appendages, and have a more slender appearance.

On the oral arms there are no very large appendages, but numerous small ones, which are situated in axils of the branches. Some are similar to the small appendages on the oral disc and belong to the cylindrical type, but the majority of them are bilaterally compressed and somewhat leaf-shaped, resembling the brachial appendages of *Netrostoma coerulescens* (Maas, 1903, Taf. v. fig. 44). These flat appendages have also both kinds of tubercles with nematocysts, but the papilliform tubercles are more numerous, and some of the appendages are closely covered with them. The internal canal broadens out inside the flat appendages and opens to the exterior at the apex.

Colour. The natural colour of the living medusa was not recorded. The specimens are now whitish and the jelly is very transparent in formalin.

Size and Measurements. (A) Largest specimen. Umbrella, flattened out, 125 mm. in diameter. Gelatinous crown 30 mm. in diameter. Oral arms, measured from centre of the disc, 60—65 mm. in length, including branches of 30 mm. Lateral thickness of the oral arms at the base 10 mm., height 15 mm. Oral disc about 50 mm. in diameter, measured across the subgenital ostia.

(B) Umbrella, flattened out, 70 mm. in diameter. Oral arms 35 mm. in length including branches of 15 mm. Oral disc 28 mm.

(C) Smallest specimen. Umbrella 30 mm. in diameter.

The Collection contains 6 specimens and they were found at Haddumati.

University College, London. 31*st December*, 1904.

Fig. 1.

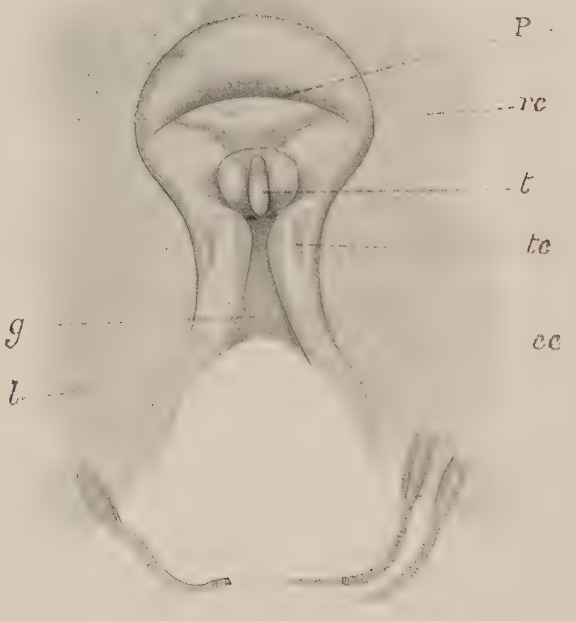

Fig. 2.

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DESCRIPTION OF PLATE XCIV.

Aurelia solida.

FIG. 1. Reproduced from a photograph. The oral or ventral side. About natural size.

FIG. 2. A sense organ. Dorsal side. × 15.

cc. = circular canal.
g. = groove.
l. = lappet.
p. = entrance to dorsal pit.
rc. = radial canal.
t. = tentaculocyst.
tc. = lateral blind branch from the canal of the tentaculocyst.

COLEOPTERA.

By D. Sharp, M.A., F.R.S.

Almost nothing has been hitherto known as to the Fauna, *Coleoptera*, of the Maldives and Laccadives; and even as to the Coleoptera of continental India but little is known except as to the more conspicuous forms. The preparation of the following list, imperfect as it is, has been therefore a matter of some difficulty, and has only been accomplished by the kindness of Mr H. E. Andrewes who possesses the largest collection of Indian Coleoptera, and who has named the species met with by Mr Gardiner.

The list is a very meagre one and no doubt will be considerably added to by any one who may make a speciality of collecting Coleoptera in the Maldives and Laccadives, as beetles are found in all sorts of out of the way places, and queer conditions. I mention this because, though the Fauna is probably to a certain extent a fluctuating one, it must not be supposed that a species that may be subsequently discovered in the Archipelago was not there in 1900 because there is nothing of the sort mentioned in this list.

Fam. **Carabidae.**

1. *Eudema tenuipunctatum* Laf., Minikoi.
2. *Dioryche* sp., Minikoi.

Fam. **Dytiscidae.**

3. *Hyphydrus renardi* Sev., Minikoi.

Fam. **Hydrophilidae.**

4. *Sternolophus rufipes* Fabr., Minikoi.
5. *Berosus* sp., Minikoi.
6. *Volvulus aeneus* Br., Minikoi.

Fam. **Staphylinidae.**

7. *Bledius brunneipennis* Fabr., Minikoi.

Fam. **Histeridae.**

8. *Saprinus speciosus* Er., Hulule, Minikoi.

Fam. **Nitidulidae.**

9. *Prometopia* sp., Minikoi.
10. *Brachypeplus basalis* Er., Minikoi.

Fam. **Colydiidae.**

11. *Xuthia* sp., Minikoi,
12. *Trachypholis erichsoni* Reitt., Minikoi.

Fam. **Cucujidae.**

13. *Hectarthrum heros* Fabr., Minikoi.
14. *Psammoechus* sp., Minikoi.

Fam. **Dermestidae.**

15. *Dermestes* sp., Hulule.

Fam. **Scarabaeidae.**

16. *Onthophagus* sp. near *limbatus* Herbst, Fainu, Maduwari, Mahlosmadulu.
17. *Oryctes rhinoceros* L., Minikoi.

Fam. **Elateridae.**

18, 19, 20. *Cardiophorus* 3 spp., Minikoi.
21. „ sp., Hulule.
22. *Monocrepidius* sp., Hulule.
23. „ „ Minikoi.
24. *Fornax* sp., Minikoi.

Fam. **Dascillidae.**

25. *Scirtes grandis* Motsch., Minikoi.

Fam. **Ptinidae.**

26. *Lasioderma* sp., Minikoi.

Fam. **Tenebrionidae.**

27. *Caedius malabaricus* Fairm., Minikoi.
28. *Opatrum* sp., Hulule.
29. *Toxicum* sp., Minikoi.
30. *Alphitobius piceus* Ol., Minikoi.
31. *Platydema* sp., Minikoi.
32. *Hypophloeus* sp., Minikoi.
33. *Strongylium* sp., Minikoi.

Fam. **Cistelidae.**

34, 35. *Cistela,* 2 spp., Minikoi.

Fam. **Oedemeridae.**

36, 37. *Nacerdes,* 2 spp., Minikoi.

38. *Nacerdes* sp., Hulule and Minikoi.

Fam. **Curculionidae.**

39. *Cratopus* sp., Minikoi, Hulule, Goidu.

40. *Amblyrhinus poricollis* Boh., Inguradu, Mahlosmadulu.

41. *Cylas formicarius* Fabr., Minikoi.

42. *Acicnemis* sp., Minikoi.

43. *Conarthrus* ?, Minikoi.

44. *Calandra* sp., Minikoi.

Fam. **Scolytidae.**

45. *Xyleborus* sp., Hulule.

Fam. **Anthribidae.**

46. *Basitropis nitidicutis* Jek., Minikoi.

Fam. **Cerambycidae.**

47. *Coptops aedificator* Fabr., Minikoi.

48. *Praonetha annulata* Chevr., Minikoi.

49. *Sybra procera* Pasc., Minikoi.

50. „ *praeusta* Pasc., Minikoi.

51. *Ropica plagiata* Gah., Minikoi.

52. *Batocera rubus* L., Minikoi.

Fam. **Chrysomelidae.**

53. *Lema* sp., Minikoi.

54. *Aulacophora foveicollis* Küst., Minikoi.

55. *Psylliodes* sp., Minikoi.

56. *Sphaeroderma* sp., Minikoi.

Fam. **Coccinellidae.**

57. *Coccinella arcuata* Fabr., Hulule.

58. *Brumus suturalis* Fabr., Minikoi.

59. *Chilocorus nigritus* Fabr., Minikoi.

60. „ sp., Hulule.

61. *Scymnus nubilus* Muls. var. ?, Minikoi.

THE CEPHALOPODA.

By William E. Hoyle, M.A., D.Sc., *Director of the Manchester Museum.*

(With Plate XCV and Text-Figures 144—153.)

LIST OF SPECIES.

Polypodidae.

1. *Polypus gardineri* n. sp.
2. „ *tonganus.*
3. „ *marmoratus.*
4. „ *horridus.*
5. „ *pictus.*
6. „ *arborescens.*
7. „ *G.*
8. „ *K.*
9. „ *L.*
10. „ sp.

Sepiolidae.

11. *Euprymna morsei.*

Sepiidae.

12. *Sepia rouxi.*
13. „ *venusta.*
14. „ *kobiensis.*
15. *Sepiella inermis.*

Ommastrephidae.

16. *Symplectoteuthis oualaniensis.*

Enoploteuthidae.

17. *Ancistrochirus lesueuri.*

The Cephalopoda collected by Mr J. Stanley Gardiner in the Maldive Islands comprise about five and thirty specimens, exclusive of a number of embryos of one species. The great majority are small Octopods, as is usually the case with Cephalopoda obtained near the shore. The general facies of these presents a remarkable likeness to the collection made by Professor Herdman in Ceylon, and several of the forms seem to be identical. After some hesitation I have described one species as new.

The prize of the collection is undoubtedly the specimen of *Ancistrochirus lesueuri,* which was found floating dead on the surface. Unfortunately its state of preservation left much to be desired, and hence the account here given of it is less complete than might otherwise have been the case. Considering the rarity of the species, however, it seems imperative to utilise the material as fully as possible.

A few Octopods collected by Mr Gardiner in Rotuma, 250 miles N.N.W. of the Fiji Islands, and sent to me some time ago by the Rev. H. M. Gwatkin, are included in the present Report.

My thanks are due to Mr J. Stanley Gardiner for the opportunity of examining the collection, to Miss Ethel M. Curwen and Mr A. D. Darbishire for drawings, and to Mr J. T. Wadsworth for the preparation of sections.

Family **Polypodidae.**

Genus *Polypus* Schneider.

1. *Polypus gardineri,* n. sp. (Figs. 144 and 145).

Localities. Hulule, Male Atoll, three specimens, ♂ [H 853, 860, 861]; one young specimen, sex ? [H 878]. Minikoi, boulder zone, June, 1899, one specimen, ♂ [H 883]. Rotuma, one specimen, ♂ [H 372].

The Body is pear-shaped, wider behind, and evenly rounded. The *mouth-opening* terminates below and behind the eyes and extends about one-third round the body. The *siphon* is short and blunt, reaching less than half-way to the umbrella margin.

The Head is small, with rather prominent eyes.

The Arms are subequal and about four times as long as the body. The *umbrella* is about equally developed all round; slightly more between the lateral arms than between the dorsal and ventral. It reaches to a point nearly half-way between the mouth and the extremities of the arms.

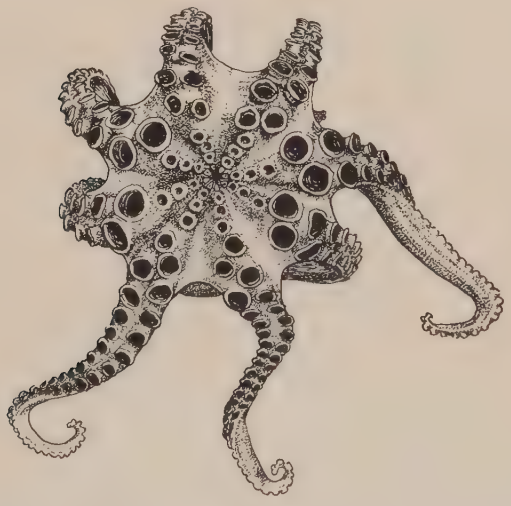

Fig. 144. *Polypus gardineri* n. sp., viewed from the oral aspect, showing the enlarged suckers on the lateral arms; × about 2½.

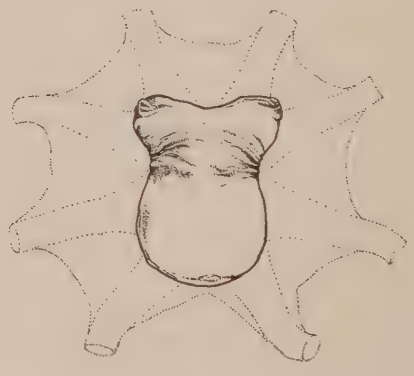

Fig. 145. *Polypus gardineri* n. sp., showing the form of the body and the rudimentary papilla over each eye; × about 2½.

The Suckers are of average size and very prominent: the fifth and sixth on the lateral arms are much enlarged (doubtless a sex character). The extremity of the *hectocotylised arm* is very small and of the form seen in *P. vulgaris,* the groove along the arm is very well developed.

The Surface is perfectly smooth all over, except that over each eye is a little fold of the integument, which may be the equivalent of the papilla seen in other specimens.

The Colour is a dull yellowish grey, plentifully sprinkled with small purplish chromatophores.

Dimensions of Specimen H 860 *in millimetres.*

Length, total (about)	50	Length of hectocotylised extremity	1
End of body to mantle margin	8·5	Diameter of largest sucker	3
End of body to eye	12	Length of first arm	32 right, 21[1] left
Breadth of body	9	Length of second arm	35 „ 26 „
Eye to edge of umbrella (between dorsal arms)	9	Length of third arm	31 „ 30 „
		Length of fourth arm	36 „ 35 „

The above description is based upon the two male specimens [860, 861] from Hulule, which though somewhat stiff and contracted are very well preserved.

Specimen 883 is 10 mm. in length of body, measured from the posterior extremity to the mantle opening; it is less shrunk than the two above-mentioned and is much paler in colour; it has a small hemispherical papilla over each eye and a faint indication of two or three minute ones on the back, and the enlarged suckers on the lateral arms are the sixth and seventh. These differences may perhaps indicate a specific distinction.

Specimen 373 resembles this last in its general appearance and paler colour, and in the fact that the enlarged suckers are the sixth and seventh. The eyes, however, are distinctly more prominent and I failed to detect any papillae above them.

Specimen 853 resembles the two first described in the characters of the arms and suckers, and is of about the same dimensions; it, however, has the small rounded papilla above each eye.

Specimen 878 also has a small papilla over each eye and a few rudimentary ones on the back, and is otherwise smooth. The suckers enlarge gradually on the lateral arms, and there is no hectocotylised extremity, and I therefore regard it provisionally as a female corresponding to the males above described, though this can hardly be regarded as certain.

I have had considerable hesitation as to the specific distinctness of these small Octopods, and it is quite possible they may eventually prove to be the young of *P. fontanianus*, *P. tonganus*, or some form nearly allied to them. The enlargement of certain suckers on the lateral arms of the males is a striking character, and has been hitherto recorded only in the case of a few forms, but it must be remembered that it may be present in any species that has been established solely on female specimens. It is also an open question as to how much stress is to be laid on the position of the enlarged suckers. In the examples referred to above they are either the fifth and sixth or sixth and seventh. In *P. fontanianus*, judging by d'Orbigny's figure (Fér. and d'Orb., **'35**, Pl. XXIX., fig. 1)[2], they are much farther removed from the mouth, and differ in the different pairs of arms of the same specimen. Their positions are indicated as follows:—

Dorso-lateral arms	11, 12, 13,
Ventro-lateral arms	10, 11, 12.

The question further arises whether the suckers grow in such a way that the specially enlarged ones come to lie farther and farther from the mouth with the growth of the individual. The matter is one which requires further investigation.

[1] Mutilated. The lengths of the arms are measured from the mouth.

[2] The figures in dark type refer to the Bibliography at the end.

On the whole the wisest course seems to me to regard these examples as types of a new species, which I have pleasure in naming after Mr J. Stanley Gardiner, the leader of the expedition.

2. *Polypus ? tonganus* Hoyle (**'86**), p. 83, Pl. VIII., figs. 1, 2.

Locality. Hulule, Male Atoll, two specimens, ♀ [H 854, 855].

Dimensions of Specimen 854 *in millimetres.*

End of body to mantle margin	22	Length of first arm	115 right, 115 left
End of body to eye	30	Length of second arm	125 „ 115 „
Breadth of body	22	Length of third arm	130 „ 120 „
Breadth of head	24	Length of fourth arm	125 „ 120 „
Eye to edge of umbrella (between dorsal arms)	20		

These examples differ from the type in the somewhat shorter arms, and the darker colouration. The papilla over the eye seems to be inconstant; where best developed it is a knob with two small pimples on its apex. The papillae on the body have the form of longitudinal keels 1 to 2 mm. in length.

3. *Polypus marmoratus* Hoyle (**'86**), p. 85, Pl. VI.

Locality. Rotuma, three specimens, 1 ♂ [H 368], 2 ♀ [H 369, 370].

These specimens present certain noteworthy differences.

H 368 is of moderate dimensions (52 mm. from the end of the body to the eye). The back is smooth with very slight wrinkles, and there are a few small papillae on the sides. The dorsal surface of the head and umbrella is strongly wrinkled, and there is a minute papilla above and behind the left eye. The tip of the hectocotylised arm agrees with Verrill's description of *Polypus bimaculatus* (**'83**, p. 121, Pl. v. fig. 1, Pl. VI.) in that it is not hollowed, and there are no ridges on its surface, which is smooth. There are, however, no enlarged suckers on the lateral arms. The ocellar spot on the umbrella is fairly definite, but there are no marble-like veinings on the surface.

Specimen 369 measures 32 mm. from the end of the body to the eye and has a number of blunt, rounded, slightly elevated papillae on the back, and there is a minute papilla above and behind each eye. The dorsal surface of the head and umbrella is much wrinkled. The ocellar spot is very distinct and surrounded by a paler ring.

Specimen 370 measures 27 mm. in the corresponding dimension. The back is wrinkled and papillate and the dorsal surface of the head and mantle very rough; there is a distinct papilla over each eye and a smaller one behind it. The eye spot resembles that of H 369: the colour of the specimen is pale, but there are dark streaks on the sides of the head which suggest the marbling from which the species derived its name.

These examples exhibit a series of modifications in the direction of *P. bimaculatus*, but as I have never seen a specimen of that species I do not feel sure of their identity.

4. *Polypus horridus* (d'Orbigny), Fér. and d'Orb. (**'35**), p. 51, Pl. VII., fig. 3; *P. aculeatus* Hoyle (**: 04 A**).

Localities. Hulule, Male Atoll, one specimen, sex ? [H 859]. North Male Atoll, 27 fathoms, three young specimens [H 895, 896, 897].

Dimensions of Specimen 859 *in millimetres.*

Length, total	150	Length of first arm .	80 right, 75 left
End of body to mantle margin . .	13	Length of second arm .	112 „ 115 „
End of body to eye	21	Length of third arm .	14[1] „ 120 „
		Length of fourth arm .	115 „ 125 „

Specimen 859 has the characteristic pale round patches with a tubercle in the centre of each, though the definition is not so clear as in d'Orbigny's figure copied from Savigny. The order of the arms according to d'Orbigny is 4, 3, 21, which is the reverse of the present specimen, but as d'Orbigny's description is based only on a figure in which the disparity is not great, I do not regard the discrepancy as very important.

The third right arm has been lost and I have not opened the specimen in order to determine its sex.

The other three specimens are very small, measuring only about 5 mm. from the end of the body to the eye, but I have no doubt they belong to the same species.

5. *Polypus pictus* Brock (**'82**), p. 603, Pl. XXXVII., fig. 3; Hoyle (**'86**), p. 92.

Locality. Mulaku Atoll, 28 fathoms, one specimen ♀ [H 872].

The only point in which this specimen does not agree with Brock's description is that the black ring in the centre of the brown patches is just as distinct on the arms as on the body, which does not seem to have been the case in the type-specimen.

I should have referred this example to *P. lunulatus* (Quoy and Gaimard) but for the fact that no pigment patches are found between the arms. I have a strong suspicion that the two forms above named are not more than varietally distinct.

6. *Polypus arborescens* Hoyle (**:04 A**), p. 189, Pl. II., figs. 8, 9, 12, Pl. III.

Localities. Hulule, Male Atoll, one specimen [H 863]. Felidu Atoll, 25 fathoms, one specimen [H 873]. Fadifolu Atoll, 23 fathoms, one specimen [H 874]. South Male Atoll, 26 fathoms, one specimen [H 875].

The largest of these examples (H 863) measures only 8 mm. from the end of the body to the eye; specimen 873 is of a deep dull purplish colour, much deeper than any of the others.

7. *Polypus* G. Hoyle (**:04 A**), p. 197, Pl. II., fig. 3.

Localities. Haddumati Atoll, found on a loose rope hanging over the stern of the schooner when at anchor; one specimen [H 881]. North Male Atoll, 27 fathoms; one specimen [H 877].

These young specimens resemble very closely two which were found by Professor Herdman in Ceylon and are alluded to in the Report on his Collection as *Polypus* G. They agree with them in general proportions, in the arrangement of chromatophores on the body and in the double row on the outer aspect of the arms. The length of the specimens from the end of the body to the eye is 8 mm.

[1] Mutilated.

8. *Polypus* K. (fig. 2).

Localities. Hulule, Male Atoll, one specimen [H 879].

This form closely resembles the one which was called "Polypus A." in the Ceylon Report (Hoyle, **:04 A**, p. 195) and at first I thought it might be a somewhat older specimen than the others. It differs, however, in several particulars; (1) there are two small papillae over each eye; (2) on the ventral surface are four circular black chromatophores, which appear as though there were normally three arranged in a triangle, one of which had somehow been divided in two; (3) the chromatophores on the outer surface of the arms are distinctly smaller and only visible in the proximal portion of it.

Fig. 146. *Polypus* K., showing the arrangement of the chromatophores on the ventral surface of the mantle; ×5.

9. *Polypus* L. (figs. 147—150).

Localities. Hulule, Male Atoll, three young specimens [H 862, 864, 880]. Funadu, Miladumadulu Atoll, one young specimen [H 871].

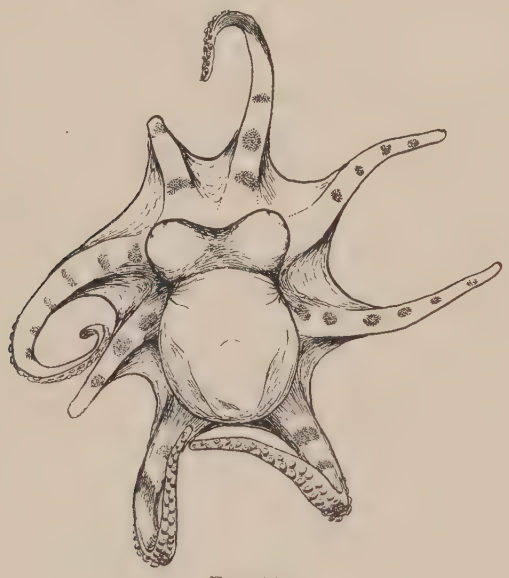

Fig. 147.

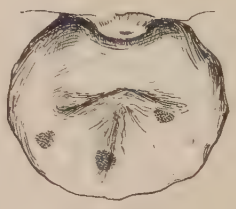

Fig. 148.

Fig. 149.

Fig. 150.

Figs. 147—150. *Polypus* L., figs. 147, 148, dorsal view, ×4, and ventral surface of mantle, ×5, of specimen 880; fig. 149, specimen 862, ×3; fig. 150, specimen 864, ×3, showing the different appearances of what are believed to be young examples of the same species due to differences in contraction on preservation.

These young specimens measure about 6 mm. long from the end of the body to the eye. They have a minute wart over each eye, three conspicuous chromatophores on the ventral surface of the mantle, and a single row along the outer surface of each arm. The figures illustrate forcibly the differences in appearance brought about by variations in contraction, in the shape of the body and the expansion of the chromatophores.

10. *Polypus* sp. (fig. 151).

Locality. Minikoi, Boulder zone, June 1899; one specimen [H 884].

This specimen is about 19 mm. in total length and has a pear-shaped body, covered with small black chromatophores on the under surface. The arms present a curious appearance, being all very short and stumpy, as though they had been bitten off. The dorsal are much the longest and the ventral the shortest; the suckers are very small.

Fig. 151. *Polypus* sp., showing the inequality in the arms, apparently due to mutilation; ×3.

Family **Sepiolidae.**

Genus *Euprymna* Steenstrup.

11. *Euprymna morsei* (Verrill) Steenstrup.

Locality. Kolumadulu Atoll, 35 fathoms, one specimen, ♀ [H 865].

For an account of this genus with references and a description of the allied species (*E. stenodactyla*), with figures of the arms and suckers, I may refer to my report on the Cephalopoda collected by the U.S. Fish Commission Steamer "Albatross" in the Pacific (**:04**), p. 24.

Undetermined Specimens.

A small specimen belonging to the family Sepiolidae which had been allowed to become dry and was too shrivelled to determine [H 876].

A large number of embryos preserved in various reagents, which are too young to determine but apparently belong to the same family.

Family **Sepiidae.**

Genus *Sepia* Linné.

12. *Sepia rouxi* d'Orbigny (Fér. and d'Orb. (**'35**), p. 271, Pl. XIX.).

Locality. Mulaku Atoll, 28 fathoms, one specimen, ♀ [H 858].

I have entered this specimen as *S. rouxi* with some hesitation. The teeth of the horny rings in the arm-suckers do not quite agree with d'Orbigny's adjective "aiguës," and the locular index of the shell is 36, while in d'Orbigny's figure it is only 23. The only other described species near it is *S. singalensis* Goodrich (**'96**, p. 3), in which the locular index is 22. The present example further resembles *S. singalensis* in its elongated form and narrow fins, but differs from it and resembles *S. rouxi* in having teeth on the rings of the large tentacular suckers. It appears thus in certain respects intermediate between the two: this

renders probable what was before Goodrich as a possibility, the suggestion that they are only varieties of the same species.

13. *Sepia venusta* Pfeffer (**'84**), p. 12, fig. 15, 15 *a*.

Locality. S. Nilandu Atoll, 36 fathoms, five specimens, two ♀, three young [H 866—870].

The largest two of the above recorded specimens agree so exactly with Dr Pfeffer's description and figure in the form of the shell and resemble his species so nearly in other respects that I feel sure their identification with it is correct. The only noteworthy differences are as follows: the tubercles and markings on the back and fins are not apparent; the teeth of the arm-suckers are very irregular and vary from ten to fourteen in number (Pfeffer gives sixteen); it is rather difficult to make out exactly the number of rows of suckers on the tentacle, but they seem to me to be six rather than eight; the teeth of the large tentacular suckers are from 26 to 30 in number, whereas Pfeffer gives them as from 44 to 50.

14. *Sepia kobiensis* Hoyle (**'86**), p. 142, Pl. XVIII., fig. 7—14.

Locality. Kolumadulu Atoll, 35 fathoms, one specimen ♀ [H 882].

Genus *Sepiella* Gray.

15. *Sepiella inermis* (van Hasselt), Fér. and d'Orb. (**'35**), p. 286, Pl. VI. *bis*, Pl. XX., Steenstrup (**'80**), p. 347, figs. 1—8 (fig. 152).

Locality. Hulule, Male Atoll, two specimens ♂ [H 856, 857].

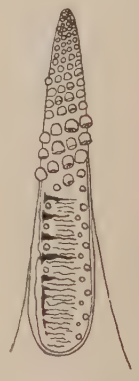

Fig. 152. *Sepiella inermis*; the hectocotylised ventral arm on the left side; ×2.

The hectocotylised arm of this species has never, so far as I am aware, been described. It is as usual in the genus the fourth on the left side (fig. 152). The proximal half of the inner face is bounded by a narrow, slightly elevated rim. Parallel to this on the ventral margin and just within it is a series of about eight small suckers, and alternating with these and a little further from the edge a series of somewhat smaller suckers. Towards the dorsal margin is a row of about four small suckers parallel with it. The surface of the arm is crossed by numerous transverse grooves, approximately parallel but at irregular intervals and of varying length, which divide the space into tracts with a rough granular surface. Between each pair of the suckers near the dorsal margin the groove deepens into a kind of pit. In one specimen these pits united to form a kind of irregular groove parallel to the dorsal margin. The distal half of the arm is occupied by suckers arranged in four rows. The first two or three are of moderate size and are succeeded by larger ones of the same dimensions as the largest suckers of the other arms. From this point they become gradually smaller towards the tip.

Family **Ommastrephidae.**

Genus *Symplectoteuthis* Pfeffer (**:OO**), p. 178, 180.

16. *Symplectoteuthis oualaniensis* (Lesson) Pfeffer.

Locality. South Nilandu Atoll, 24 fathoms, one specimen in poor condition [H 885].

Family **Enoploteuthidae.**

Genus *Ancistrochirus* Gray.

17. *Ancistrochirus lesueuri* (Pl. XCV. and fig. 153).

Onychoteuthis Lesueurii Fér. and d'Orb. (**'35**), Pl. XI., fig. 1—5; Pl. XIV., fig. 4—10.

Enoploteuthis Lesueurii d'Orb. *in* Fér. and d'Orb. (**'35**), p. 339.

„ „ d'Orb. (**'45**), p. 402, Pl. XXVII., fig. 10.

Ancistrochirus Le Sueurii Gray (**'49**), p. 49.

? *Abralia megalops* Verrill (**'83**), p. 105, Pl. III., fig. 4; (**'84**), p. 143, Pl. XXVIII., fig. 2; (**'85**), Pl. XLIV. fig. 2.

Ancistrochirus lesueuri Pfeffer (**: 00**), pp. 165, 167.

Ancistrochirus Lesueuri Joubin (**: 01**), p. 60.

Locality. Felidu Atoll, found floating quite dead; one specimen, sex? [H 852.]

The Body is roughly conical, tapering gradually towards the posterior, where it ends in a rather blunt extremity. It is not so long and tapering as is indicated in d'Orbigny's figure (Fér. and d'Orb., **'35**, Pl. XIV., fig. 4). The *fins* extend from about 1 cm. behind the margin of the mantle to within about $\frac{1}{5}$ of its posterior extremity. They are rhomboid in form with the lateral angles rounded and very thick and muscular. The breadth of the two combined is somewhat greater than the length. On either surface are seen fine parallel striations proceeding from the middle line outwards. On the inferior surface are to be seen the *tubercles* figured by d'Orbigny. Some of them are hard and easily perceptible by the finger, others softened and perceptible only by the eye as pale greyish round spots. Their exact distribution could not be made out owing to the shrinking of the tissues; so far as could be ascertained they agree generally though not precisely with his figure. The *mantle-margin* extends much farther forwards dorsally than ventrally; it terminates in a blunt point above and is excavated in a wide curve below. The *mantle-connective* consists of two straight linear ridges about 2·5 cm. in length. The *siphon* extends forward to a level with the hinder margin of the eye-ball, tapering but slightly. It is provided with a valve and is supported above by two suspensory ligaments. The *cartilages* at the base of the siphon measure 1·8 × 0·7 cm. They are of an elongated reniform outline with a straight groove longitudinally somewhat nearer the dorsal than the ventral margin.

The Head is so shrivelled that its original outline cannot be determined, but judging by the wrinkling of the integument it must have attained a considerable breadth. The *eyes* are very large, the lens being 1·5 cm. in diameter. The *ocular aperture* measures 3·2 × 2·5 cm. and has a small rounded notch on the anterior side.

The Arms are somewhat unequal, the third and fourth pairs are the longest and sub-equal, the first by a small amount the shortest. They are thinner and less muscular at the base than about three-fifths up where they are thickest and strongest (Pl. XCV. fig. 5). Beyond the middle they taper gradually to blunt points. The outer aspect is rounded, the inner face is narrow and bounded on either side by a membrane which is so broad as almost to conceal the hooks when folded against them (Pl. XCV. fig. 4). The arms of the third pair are the stoutest and in the proximal third have a strongly projecting keel (Pl. XCV. figs. 4, 5).

The Hooks are in a single zigzag row, and in some of the arms the surface on which they stand is so narrow that they seem to form a single series. The hooks are strong and curved and of the shape shown in figs. 7 and 8 and completely covered by a membranous hood (Pl. XCV. fig. 6).

The Tentacles are about twice as long as the arms, with a cylindrical, slightly flattened stem. The *club* is flattened and has a membranous keel on the outer side. At the base is a group of [illegible] organs consisting of five suckers and four pads on the right side and four suckers and five pads on the left (Pl. XCV. figs. 1, 2). These are succeeded on the ventral margin by a row of eight hooks of which the third and fourth are the largest while the fifth to the eighth gradually diminish. On the dorsal margin are nine hooks much less unequal in size. At the extremity of the club are about thirty minute suckers with smooth rings (Pl. XCV. fig. 3).

The Surface is smooth excepting for the tubercles above mentioned.

The Colour is throughout of a dull purplish which appears to be somewhat soluble in alcohol as it stains the fingers on handling it.

The Pen is leaf-shaped, the breadth being about one-fifth of the length. The two outer thirds are very thin, the middle third much thicker and rising to a strong rounded keel in the middle line. There is a minute hollow cone at the posterior extremity about 3 mm. in length. The median keel stops suddenly about 3 cm. from the anterior extremity and the front of the pen is thin like the lateral margins and is bluntly pointed.

Dimensions in centimetres.

End of body to mantle margin	20	Length of first arm	12 right, 11·5 left
End of body to eye	22·5	Length of second arm	13 „ 13 „
Breadth of body	5·5	Length of third arm	14·5 „ 13·5 „
Breadth of head	5·5	Length of fourth arm	12·5 „ 14·5 „
Eye to edge of umbrella (between dorsal arms)	4·3	Length of tentacle	27 „ 26 „
		Suckers on first arm	24 „ 32 „
Length of fin	14	Suckers on second arm	40 „ 32 „
Breadth of fin	16	Suckers on third arm	40 „ 43 „
Length of pen	15·7	Suckers on fourth arm	30 „ 50 „

Excepting for the fragments described by Joubin, this is only the second example of this species on record and I have therefore thought it right to give as full a description of it as the defective state of preservation allowed, as well as references to all the sources where information regarding it is to be found.

I think it most probable that Verrill's *Abralia megalops*, the largest specimen of which measured only 15 mm. in length of mantle, will prove to be the young of this species.

Structure of the Luminous Organs.

The examination of the luminous organs in this specimen was attended with great difficulty owing to its unsatisfactory state of preservation. It had evidently lain for some time in the sea-water and had undergone considerable maceration. Of some of the organs no trace could be found in positions where they might have been expected; others were scarcely perceptible to the eye and not at all to the touch. The description, which follows, is consequently very

incomplete, and especially as regards the histology must be regarded as a provisional account, such as alone was possible under the circumstances.

To the naked eyes those organs which were best preserved have an ocellar appearance, with an opalescent grey convex centre, and a darker ring. To the touch they feel like cartilaginous nodules. Measured externally they appear to be about 2 mm. in diameter, but the study of sections shows that the actual organ is much smaller than this.

One of the organs was excised and a series of sections perpendicular to the surface of the body prepared, and the general relation of the component parts is shown in the accompanying sketch (fig. 153) and in greater detail on the Plate. It will be convenient to describe the appearances presented beginning with the deepest layer and gradually proceeding to the surface.

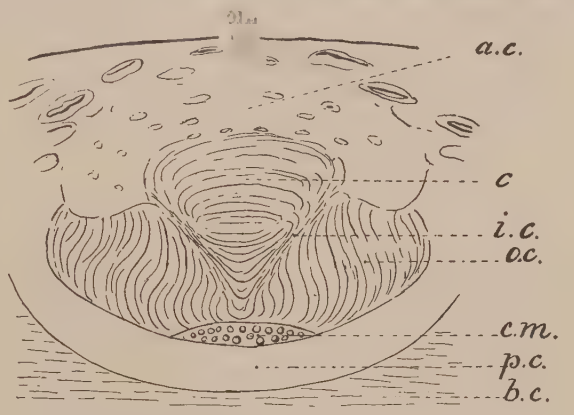

Fig. 153. Diagrammatic section of the luminous organ; *a.c.* anterior cap, *b.c.* basal connective tissue, *c.* cone, *c.m.* cell mass, *i.c.* inner cup, *o.c.* outer cup, *p.c.* posterior cup.

1. The *Basal Connective Tissue* (Pl. XCV. fig. 9, *b.c.*) consists of fine trabeculae forming a rather open mesh-work, the fibres of which lie in general parallel to the surface. Many of the interspaces contain nuclei. Here and there may be seen what appear to be rounded aggregations of nuclei. Blood vessels (*bl. v.*) are large and abundant. The thickness of this layer is about 0·2 mm.

2. *The Posterior Cup* (Pl. XCV. fig. 9, *p.c.*) is separated from the layer just described by a layer of thin chromatophores (*ch'.*). It has the form of a spherical shell, about 0·8 mm. in diameter, 0·13 mm. in depth inside, and 0·16 mm. in thickness. In the sections which were stained with haematoxylin and eosin it is of a deep bright red colour. It forms the deepest portion of the luminous organ proper, and appears to be more dense in structure and is more deeply stained in the upper than the lower portions. It is almost homogeneous in appearance and is broken up by minute cracks into portions, disposed parallel to the surface; this may, however, be due to the action of reagents. The nuclei are very numerous, small and elongated, and lie parallel to the surfaces of the layer; they stain very deeply, being almost black in colour.

3. *The Cell Mass* (Pl. XCV. fig. 9, *c.m.*) has the form of a flattened doubly convex lens, about 0·4 mm. in diameter and 0·06 mm. thick; it stains of a deep purple colour. No separate cell-outlines are distinguishable, but it is full of small nuclei of very various shapes but mostly ovoid and inclined at different angles to the plane of the lens.

The portion of the organ lying above this cell-mass consists of a series of three structures fitting one inside the other, which I have called passing from below upwards the outer cup, the inner cup and the cone. It must be mentioned, however, that they are not separated from each other by a clear line of demarcation, but that the constituent elements of each pass uninterruptedly into those adjoining.

The Outer Cup (Pl. XCV. fig. 9, *o.c.*) may be described as roughly resembling a cheese with bulging sides, the interior being hollowed out into a conical space, which is so deep that

its bottom appears to be nearly perforated and to let the inner cup (*i.c.*), which lies within it, come almost into contact with the cell-mass. It is about 0·8 mm. in diameter and 0·32 mm. deep. It is made up of fibres which arise from the surface of the cell-mass, pass at first in an outward direction, then bend upwards, and at their superficial extremities turn slightly outwards again and join the outer surface of the inner cup. In the deeper portion the fibres stain of a reddish colour, and are approximately parallel and fairly thick, leaving but small interspaces between them; whereas in the more superficial portion they stain of a purplish hue, and become thinner and more curly with rounded lacunae between them.

The Inner Cup (Pl. XCV. fig. 9, *i.c.*) fits into the outer cup just described, and is 0·32 mm. in depth and 0·4 mm. in diameter, it rests with its apex downwards, reaching almost through the outer cup to the cell-mass as above-mentioned. It is almost impossible to assign a definite thickness to its walls, for it is not so much an independent structure in itself as a boundary where the constituent fibres of the outer cup and the cone come together.

The Cone (Pl. XCV. fig. 9, *c.*) fits into the interior of this inner cup, and measures about 0·45 mm. in diameter by 0·37 mm. in height. It consists of fibres resembling those of the funnel, but differing from them in direction, for, arising from the inner surface of the cup, they pass in its deepest portion downwards, forming, so to speak, a lining to it, and passing in loops from one side to the other. Proceeding from below upwards their course is gradually less and less concave to the surface, until about half-way up the cone they pass horizontally across from one side to the other. Above this they become convex to the surface, and the convexity gradually increases until in the upper layers they become strongly arched. As in the case of the outer cup the deeper part consists of thicker, more or less parallel fibres with narrow interspaces, whilst more superficially the fibres are thinner and more wavy, and the spaces between them are rounded. The uppermost part of the cone passes imperceptibly into the cap which lies immediately upon it.

The Anterior Cap (Pl. XCV. fig. 9, *a.c.*) has the form of a hollow lid with a thickened margin, which fits over the convex base of the cone and surrounds its lower portion. It is 0·75 mm. in diameter, 0·37 mm. in thickness at the margin, and 0·2 mm. at the centre. It is composed of a kind of cartilage, the matrix of which is almost hyaline in the marginal portions (fig. 10) with nucleated cells lying in rounded lacunae, which average about 0·015 mm. in diameter. In the central part this matrix is traversed by numerous fibres, whose direction is generally speaking parallel to the surface. Proceeding downwards from the superficial layers the cartilaginous character becomes less and less marked and the fibres more numerous, until this part of the organ passes without a definite boundary into the cone just described.

In the upper portion of the cap are small chromatophores, consisting of a lacuna, in which is a nucleus with a number of pigment-granules scattered around it (fig. 9, *ch″*.). In the connective-tissue surrounding the organ, and especially in its superficial layer, are a number of large chromatophores (fig. 9, *ch‴*. and fig. 11); each of these consists of a large ovoid lacuna in the centre of which is a thin sac, whose walls are deeply permeated with pigment. In some cases it would appear as though the pigment had been aggregated in one side of the sac, and the other had disappeared altogether, so that there seems to be a single pigmented membrane stretching across the lacuna. Every vestige of the superficial epithelium has entirely disappeared owing to the maceration undergone by the specimen.

In attempting to determine the function of the different parts of this organ, we have only the somewhat problematical analogy of other organs to guide us. It seems to me probable that the cell-mass is the source of light. If this be so it would seem natural to regard the posterior cup as a kind of reflector, and the structures fitting one inside another in front of the cell-mass as a system of lenses. To the cartilaginous anterior cap is no doubt to be attributed the hardness of the organ to the finger.

There is but little resemblance between the structure of the different parts of this organ and that of others which I have examined. The fibrillar appearance of the cup and cone does, however, recall the fibrous mass composing the outer layer of the siphonal organs of *Pyroteuthis margaritifera* (Hoyle, **:02**, p. 11, fig. 5), whilst it resembles less closely the equatorial collar or ring in *Pterygioteuthis giardi* (Hoyle, **:04**, p. 55, Pl. IX. fig. 6, *co.*).

Apart from these resemblances this organ does not seem to be exactly comparable with any of those hitherto described, and it adds one more to the already numerous types of luminous organs now known to exist in the Cephalopoda.

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EXPLANATION OF PLATE XCV.

Ancistrochirus lesueuri.

FIG. 1. The club of the right tentacle, front view. × 2.

FIG. 2. The carpal group of suckers and fixing cushions of the left tentacle. × 2.

FIG. 3. The club of the right tentacle, side view. × 2.

FIG. 4. Part of the third arm on the left side, front view. × 2.

FIG. 5. „ „ „ side view. × 2.

FIG. 6. A hook from one of the lateral arms, with its sheath and stalk. × 6.

FIG. 7. Hook removed from its sheath, front view. × 6.

FIG. 8. The same hook, side view. × 6.

FIG. 9. Section of a luminous organ. × 70.

FIG. 10. Portion of the cartilaginous rim of the anterior cap. × 350. (*A* in fig. 9.)

FIG. 11. A chromatophore from near the equatorial region of the organ. × 250. (*B* in fig. 9.)

FIG. 12. Portion of the section of the cell-mass (above) and posterior cup with the layer of chromatophores below. × 350. (*C* in fig. 9.)

These letters have the same significance in all the figures.

a.c. anterior cap.
b.c. basal connective tissue.
bl.v. blood-vessels.
c. cone.
c.m. cell mass.
ch'. chromatophores separating the basal connective tissue from the posterior cup.
ch''. chromatophores of the upper part of the cone.
ch'''. chromatophores of the surrounding connective tissue.
i.c. inner cup.
o.c. outer cup.
p.c. posterior cup.

POSTSCRIPT.

In preparing this report for press a specimen (H 853) was unfortunately overlooked, though erroneously entered in the register as a male, about which a few words seem desirable. I take it to be a more mature specimen of *Polypus gardineri*. It differs from the description given on p. 976 only in one or two small particulars; the arms are a little longer in proportion and there are indications of a few minute papillæ on the back in addition to the one over each eye. The specimen being a female there are no enlarged suckers on the lateral arms.

The left dorsal arm has been lost at the level of the umbrella and a small slender tip 2 cm. in length is growing out in its place. In several places the suckers are very crowded and appear to be in three rows. I have elsewhere (**'86**, p. 78) expressed the opinion that the genus *Tritaxeopus* Owen is based on a similar irregularity.

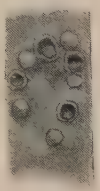
Dimensions of Specimen H 853 *in millimetres.*

Length, total	52	Length of first arm	36 right, 8 left
End of body to mantle margin	6	Length of second arm	39 „ 44 „
End of body to eye	8	Length of third arm	35 „ 34 „
Eye to edge of umbrella, between dorsal arms	5	Length of fourth arm	33 „ 44 „
„ „ „ lateral „	7		

The following corrections are needed on p. 976:

Line 4, *for* "three specimens, ♂," *read* "two specimens, ♂; one ♀."
Line 7, *for* "mouth-opening," *read* "mantle-opening."

1



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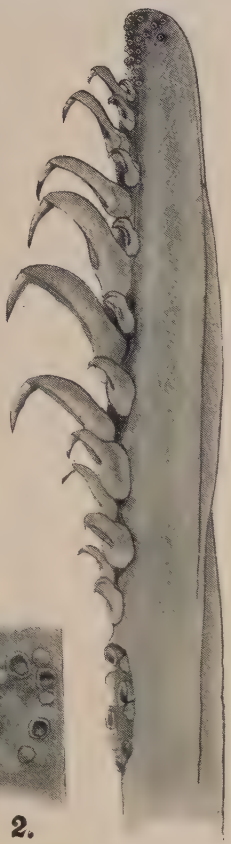

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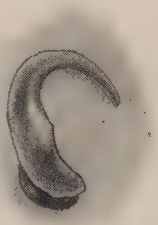

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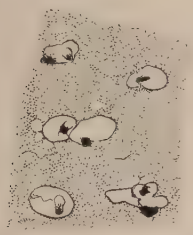

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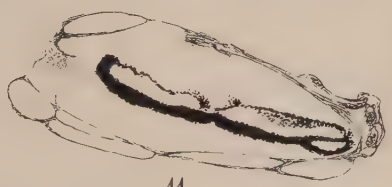

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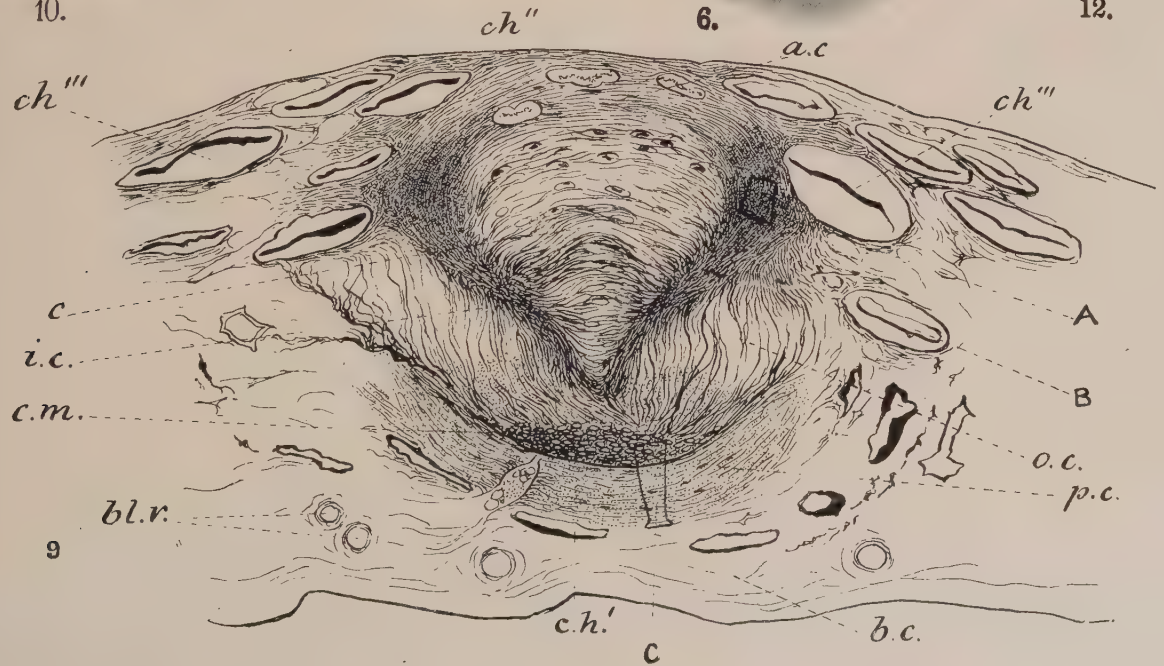

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C

NOTES ON THE COLLECTION OF COPEPODA.

By R. Norris Wolfenden, M.D. Cantab., F.L.S., F.Z.S.

(With Plates XCVI—C.)

The collection of Copepoda made by Mr J. Stanley Gardiner around the Maldive Islands, and handed to me for examination and determination is extremely interesting, especially when compared with that made by Professor Herdman on the Ceylon Pearl Fishery Banks. As the Maldive Archipelago lies between 7° 7′ N. to 0° 42′ S. it occupies a length of about 540 miles, and is distant from Ceylon about 7° or about 420 miles in a westerly direction. Notwithstanding this short distance there is a very striking difference in the fauna of the two regions. In the list of species given by Thompson and Scott of the Ceylon banks are enumerated 78 species of *Harpacticidae*, amounting to over one quarter of the whole number of species determined. In the Maldive Archipelago, the number of purely littoral as distinguished from the pelagic *Harpacticidae* is very small. Of the latter occur four species, viz., *Microsetella atlantica, Setella gracilis, Miracia efferata, Clytemnestra scutellata* and *rostrata*; of the former (littoral) only five or six species with not more than a dozen examples altogether. This paucity of *Harpacticidae* is in striking contrast to the richness in the same group of the Ceylon Fishery Banks, and seems difficult to account for, since Mr Gardiner's collections were made both in lagoons and the open sea. Dahl has already remarked upon the occurrence of purely oceanic forms round oceanic islands,—"So scheinen sie die Küsten der oceanischen Inseln weit näher zu kommen als den Festland Küsten, namentlich wenn es sich an letzteren von tiefe Buchten handelt, oder von Stellen an welchen Flüsse ausmünden[1]."

Very little work with tow-nets has been done, or at least published, concerning the Indian Ocean[2].

[1] *Deutschen Zool. Gesellschaft*, Leipzig, 1894, April.

[2] "Leider liegen uns aus dem indischen und pacifischen Ocean nicht entsprechend zahlreiche Fänge vor und von manchen Stromgebieten jener Meere wissen wir noch gar nichts. Es ist deshalb klar, dass unsere Angaben hier weit unsicherer ausfallen werden. Ausser den wenigen, theilweise noch unsicheren Fundorten, welche wir Dana und Brady entnehmen können, liegt hier namentlich die Giesbrechtische Bearbeitung des Materials der Chierchia-Expedition vor. Ich selbst habe ausserdem das von Herrn Dr Schott und Capitän Bruhn im indischen Ocean gefangene Material und einige von Behn auf der Galathea-Expedition im pacifischen Ocean gemachte Fänge in Händen. Zuverlässige Angaben über die verticale Verbreitung der Tiefenthiere fehlen ganz. Die von Giesbrecht gegebenen Zahlen besitzen geringen Werth, weil es sich meist um Tiefen handelt, bis zu welchen ein offenes Netz herabgelassen wurde." Dahl, *loc. cit.*

Dahl lays down the following propositions[1]:

1. The deeper living kinds are in all three oceans completely, or nearly completely, alike, and this applies to the tropics. Conditions of life in deeper parts of ocean are the same.

2. In the Indian and Pacific Oceans, the surface-living animals of the tropical parts are either exclusively or nearly the same, intercommunication taking place by the warm streams.

3. The Copepods of the tropical surface regions of the Atlantic are different in many of their kinds from those of the Indo-Pacific Oceans. There occur certain very nearly related kinds, also vicarious types. The physical relations in both oceans are similar and yet somewhat different, great areas of the Pacific existing permanently warmed over 29°, whilst in the Atlantic the highest temperature is about 28°. Intermixture is further arrested at the south point of Africa by the meeting of a colder Atlantic with a warm Indo-Pacific stream.

The most southerly portion was touched by the "Challenger," south of Kerguelen Island, *i.e.* between 45°—60° S., from which Brady records 16 species of Copepoda, seven of which appear in the Maldive Archipelago and are marked with an asterisk in the following list[2]: *Aetideus armatus, Calanus propinquus, *Drepanopus pectinatus, Rhincalanus gigas, Scolecithrix minor, *Eucalanus attenuatus, Hemicalanus aculeatus, *Pleuromamma abdominalis, Heterochaeta spinifrons, *Leuckartia flavicornis, *Euchaeta prestandreae, *Candace truncata, *Sapphirinella stylifera, Pseudothelestris imbricata, Zaus spinatus, Machairopus idyoides.*

In the voyage of the "Belgica[3]," the Copepoda of which were reported upon by Giesbrecht, and the limits of which were 69° 48′ and 71° 18′ S., during April—December, 1898, the following species were recorded: **Calanus acutus, C. propinquus, Ctenocalanus vanus* (recorded by Wolfenden from the Faroe Channel, N. Atlantic and West of Ireland: also by Farran from the W. of Ireland), **Euchæta antarctica, *E. austrina, *Heterorhabdus austrinus, *Metridia Gerlachei, Microsetella atlantica, Monstrilla conjunctiva, Oithona similis, *O. frigida, Oncœa conifera, O. curvata, O. notopus, *Pseudocalanus pygmaeus, *Racovitzanus antarcticus, *Rhincalanus grandis, *Scolecithrix glacialis, *Stephus longipes.*

Littoral species, **Cyclopina belgica, *Dactylopus antarcticus, *D. crassus, *Ectinosoma antarctica, *Idya racovitzai, *Nitokra gracilimana, *Idya tenuimana, *Harpacticus furcifer, H. brevicornis, H. chelifer, Scottocheres stylifer.*

Those marked with an asterisk are new species.

Heterorhabdus austrinus	is nearly related to	*H. clausi* and *norwegica*,	}	Northern species.
Metridia Gerlachei	„ „	*M. lucens*,		
Oncœa curvata	„ „	*O. subtilis*,		
Idya tenuimana	„ „	*I. furcata*,		
Harpacticus furcifer	„ „	*H. flexus*		
Rhincalanus grandis	„ „	*R. gigas*[4],	}	Southern and Northern species.
Scolecithrix glacialis	„ „	*S. alyssalis*[5]		

[1] Dahl, *Verhand. Deutschen Zool. Gesellschaft*, Leipzig, 1894, April.

[2] *Challenger Report*, Copepoda, Brady.

[3] Giesbrecht, *Voyage du Belgica*, Copepoden, 1902.

[4] Recorded by Scott from the Firth of Forth, Scotland.

[5] Recorded by Wolfenden from the Atlantic, West of Ireland.

Of these species seven are undoubtedly bipolar (viz. *Microsetella atlantica, Oithona similis, Oncœa conifera* and *notopus, Pseudocalanus pygmaeus, Harpacticus chelifer* and *Ctenocalanus vanus*): and seven others are very closely related to boreal species.

Not many of these however find their way apparently into the tropical parts of the Indian Ocean, at least in the Epiplankton, viz. *Microsetella atlantica, Oithona similis, Oncœa conifera* and *notopus*, and these are species which are eurythemic and eurybathic.

Between 45° S. (Kerguelen Island) and Southern India (Ceylon) no work appears to have been done[1], and there is a huge gap to be filled by future observation. This, embracing part of the Indian Ocean to a depth of 2000 fathoms and over, should yield results of very great interest, when observations are made, especially with efficient deep-water closing-nets. This, in fact, is what is urgently wanted throughout the Indian Ocean and Arabian Sea, the collections brought home up to the present being surface gatherings. Clearly there are obstacles in the way of admixture of surface and epiplanktonic forms between the Southern Ocean and the Atlantic and the Indian Ocean, the Copepod fauna of which greatly resembles that of the Pacific, intermixture being possible and easy. We should not however expect to find such obstacles in the admixture throughout the oceans of deep water of mesoplanktonic forms since the conditions physically more nearly approximate.

Of the records of surface gatherings in the Arabian Sea, Indian Ocean, and Southern Ocean we have the following:

Cleve. Record of a voyage made by Thorild Wulff to and from Bombay. *Arkiv für Zoologie*, Band I., 1903[2].

Cleve. Plankton organisms from the Indian Ocean and Maldive Archipelago. *Kong. Sv. Vet. Akad. Handlingar*, B. 35, N.O. 5.

Scott, A. Some Red Sea and Indian Ocean Copepoda. *Trans. Liverpool Biol. Soc.*, vol. XVI., 1902.

Thompson, I. C., and Scott, A. *The Copepoda of the Ceylon Pearl Fishery Banks*, 1902[3].

[1] This gap has been now partially filled by the collections of the German ship "Gauss," a very extensive series being now in my hands undergoing examination, and comprising the area from the South of Madagascar to the ice of Kaiser Wilhelm II. Land.

[2] The result of examination of four collections:

(1) between Aden and Java in March, 1897, by Dr Nyman;

(2) between Aden and Java in February, 1899, by Dr Aurivillius;

(3) in the Malay Archipelago, May—Sept., 1899, by Dr Aurivillius;

(4) from 45° S.—22° E. to 30° S.—91° E., 1899—1900, by Dr Willemsen;

all surface collections, comprising 86 species.

The similarity of the Copepod Fauna of the Malay Archipelago with that of the Arabian Sea is indicated by the following list of captures in this latter region:

Acartia erythrea, spinicauda, tonsa, Acrocalanus gibber, longicornis, pediger,—Calanopia Aurivillii, elliptica,—Calanus Darwinii, minor, pauper, vulgaris,—Calocalanus pavo,—Candace catula, pachydactyla, simplex,—Centropages calaninus, furcatus, gracilis, orsinii,—Clausocalanus arcuicornis, furcatus,—Clytemnestra scutellata,—Copilia mirabilis,—Corycæus Danae, elongatus, furcifer, gibbulus, gracilicaudatus, longistylis, obtusus, ovalis, robustus,—Eucalanus attenuatus, crassus, monachus, mucronatus, subcrassus, subtenuis,—Euchaeta concinna, longicornis, marina,—Euterpe acutifrons,—Heterochaeta papilligera,—Labidocera acuta, Kröyeri, minutum, nerei, pavo, —Leuckartia Clausi, flavicornis,—Metacalanus Aurivillii, —Microsetella atlantica,—Monops armatus, regalis, strenuus,—Oithona brevicornis, nana, plumifera, rigida, similis,—Oncœa conifera, media, mediterranea, venusta,—Paracalanus aculeatus, parvus,—Pleuromamma abdominale, gracile,—Pontellina plumata,—Pseudodiaptomus Aurivillii, Reticulina Aurivillii (=Porcellidium),—Rhincalanus cornutus,—Sapphirina auronitens, metallina, nigromaculata, vorax,—Scolecithrix Bradyi, Danae,—Setella gracilis,—Temora discaudata, stylifera, —Tortanus gracilis.

For the Malay Archipelago the temperature reaches from 25°—29° C. and the salinity from 30—33 (and over) per mm. (i.e. between 0°—10° S.).

[3] The Report of Thompson and Scott deals with Calanidae 44 species, Centropagidae 29 species, Pseudocyclopidae 1 species, Candaciidae 10 species, Pontellidae 31 species, Cyclopidae 8 species, Harpacticidae 78 species, Oncœidae 8 species, Corycaeidae 29 species, Ascidicolidae 3 species, Lichmolocidae 13 species, Asterocheridae 18 species, Ergosilidae 2 species, Caligidae 4 species, Chondrocanthidae 2 species, Lerniopida 3 species.

Giesbrecht. Elenco dei Copepodi pelagici raccolti dal' tenente di vascello G. Chierchia, durante il viaggio della R. Corvetta Vittor Pisani, e dal tenente di vascello, F. Orsini, nel Mar Rosso nel 1884. *Accad. Lincei*, vol. 4, 5, 7.

Giesbrecht. *Ueber pelagischen Copepoden des Rothen Meeres*, 1896.

Comparing the records of Copepoda taken in these various expeditions we find (omitting the littoral *Harpacticidae*)

from the	Gulf of Manaar, Ceylon,	139 species.
„ „	Arabian Sea and Red Sea	111 „
„ „	Malay Archipelago	83 „
„ „	Maldive Archipelago	117 „

Many of these are also common to the Mediterranean, viz. 66 species, and 37 species also appear in the North Atlantic. Of the Copepoda of the southernmost part of the Indian Ocean and Antarctic, it is evident that the further south the more characteristically distinct is the fauna[1], for though seven species of Brady's list find a habitat in the tropical Indian Ocean, only three or four of Giesbrecht's Antarctic list occur in this area and these are also boreal (*Microsetella atlantica, Oncœa conifera,* and *notopus, Oithona similis*).

While there are amongst the Antarctic species some which, as Giesbrecht points out, are very closely allied to northern species, viz., *Heterorhabdus austrinus, Metridia Gerlachei, Oncœa curvata, Rhincalanus grandis, Scolecithrix glacialis, Idya tenuimana, Harpacticus furcifer,* so there are in the tropical part of the Indian Ocean species which are very closely related to their Atlantic allies[2], but have undergone a variation, even occasionally amounting to specific difference. This is instanced in the case of *Bradyidius armatus,* which in the Mediterranean agrees with the Atlantic form, but in the Maldive Archipelago, though similar in all other respects, is only half the size; in *Paracalanus parvus,* which certainly presents varietal differences from the northern species (smaller, with more numerous spines, and less slender feet); in *Pleuromamma Indica,* which has a near relationship with *Pl. robusta,* Dahl, and is probably that species which has at some antecedent period found a habitat in the Indian Ocean, and undergone such varietal changes as to amount to specific differences; and in several species (which will be appropriately referred to subsequently) in which the tail hairs have undergone a most remarkable subdivision, doubling, or more than doubling, the area which they would ordinarily cover. It is well known that species, apparently the same, found in the boreal region have, when compared with those of the more southern and warmer areas, often undergone some variation (especially is this the case as to average size), and that some species are known to vary very greatly within certain defined limits, e.g. the common *Calanus finmarchicus* in the 5th foot, *Temora* species in the length and form of the furcal segments, *Metridia lucens* ♂ in the position of the clasping antennæ (indifferently right or left sided), &c.

[1] Since the above was written, the collections made by the German Antarctic Expeditionary ship, the "Gauss," and also those made by the "Discovery" Antarctic ship, have been placed in my hands. The first-named has been only partially examined as yet, but so far as I have gone I find a Copepod fauna quite distinct from that of the Indian Ocean, and characteristically different from that of the boreal and polar regions as at present known.

[2] Alcock (*Naturalist in the Indian Seas*) speaks of the remarkable similarity of the bottom fauna of the Laccadive Sea with that of the Atlantic.

[3] First pointed out by Vanhöffen (Grönlands Expedition), frequently observed by me in the Faroe Channel specimens and lately also by Farran (Report Irish Fishery Board).

These small variations which are perhaps caused by, or assisted by, difference of environment, are most probably the commencement in varietal differences of anatomical changes which in time will amount to specific differences. The same general process is seen in the boreal Atlantic in such genera as *Gaetanus* and *Gaidius* in which the species, though closely allied to the Pacific forms, are generally distinctly and specifically different, also in the *Aetideus armatus* of the Mediterranean and of the North Atlantic, and in some *Xantho-calanus*. While in the case of similarity of the Copepod fauna of the Antarctic with that of the Arctic region such intermixture is possible by means of the deep continuous layer of cold-bottom water, an intermixture of species between the Indian Ocean and Atlantic is rendered almost impossible by physical conditions, the Agulhas current forming a sufficient barrier. The pelagic Copepod fauna of the Indian Ocean is much more nearly allied to that of the Pacific and Mediterranean than the Atlantic[1], and such species as are common to the Indian Ocean and Atlantic may perhaps be regarded as the existing remnant in the former ocean of a fauna which was common to both, before physical barriers arose to prevent intermixture, especially heightened temperature and increased salinity locally, and the presence of great water barriers like the Agulhas current.

The paucity of littoral forms in the Maldive group is difficult of explanation. Abundant as they apparently are in the Gulf of Manaar, the distance of 500 miles only does not appear to be a sufficient barrier to admixture[2]. That a littoral Harpacticide can exist at the bottom at 400—500 fathoms is proved in the case of *Longipedia coronata* which at two different localities I have found in bottom scrapings of the Atlantic, West of Ireland, at this depth. Water of 1000 fathoms depth separates the Maldive group from the Indian mainland, at which depth the temperature may probably be not more than 35°—38° F.[3] It remains to be proved that this is a sufficient barrier. The islands are of much more recent growth than the mainland, near which a rich Copepod fauna has probably existed from time immemorial. Possibly the water barrier has remained since then, a sufficient obstacle to the extension of the main coast littoral Copepod fauna, though it has not been, or could not have been expected to be, such a barrier to species of other groups, which are essentially pelagic.

A very small part of the Antarctic Copepod fauna appears in the warmer part of the Indian Ocean and *vice versâ*, and these three or four species are cosmopolitan. While it is possible that some representatives of the Southern Ocean fauna may find their way into the Indian Ocean by the cold undercurrent, observations are wanting to demonstrate this. Deep tow-nettings in the Indian Ocean are greatly required. So far our knowledge is limited to the forms which occur at or near the surface.

The following species which occur in the Maldive collections do not appear in the lists of Thompson and Scott, or Cleve; *Bradyidius armatus*, *Calanus Caroli*, *Acrocalanus Gardineri*,

[1] While numerous observations are continually extending the area of distribution of known forms, it is fallacious to base arguments upon statistics of distribution in the great oceans. In general terms about 90 °/₀ of the pelagic Copepoda of the Indian Ocean occur in the Atlantic and its offshoot the Mediterranean, and of the whole number about 40 °/₀ occur also in the boreal region of the Atlantic. Of the 90 °/₀ of Atlantic species mentioned above at least 25 °/₀ are purely Mediterranean, i.e. have not as yet been recorded from the Atlantic. Though an offshoot of the Atlantic Ocean this partially enclosed sea, as is well known, is quite different in its physical characters.

[2] Such few species as do occur in the Maldive collection are quite specifically distinct from those recorded from the Gulf of Manaar.

[3] In the Laccadive Sea at 1000 fathoms the temperature is 38° F., at 1300 fathoms 35° F., but 250—300 species of 160 genera of many different families are found in this depth. Alcock, *Naturalist in Indian Seas*, p. 166.

Euchaeta Indica, Thaumaleus tropicus, Parapontella brevicornis, Euchirella bella, Pleuromamma Indica, Pleuromamma ziphias, Haloptilus longicornis, Haloptilus spiniceps, Anomalocera Pattersoni, Corycaeus amazonicus. Also *Peltidium elegans, Porcellidium tuberculatum, Sappirella abyssicola,* Scott (Gulf of Guinea), *Dactylopus Maldivensis,* besides several varieties of known species referred to subsequently.

The drawings which accompany this paper are from the pencil of Miss Marion Lees, and are distinguished by the accuracy and finish which characterises all her work.

Some of the more uncommon and debatable forms together with a few new forms are discussed in this paper. For the rest great care has been taken by dissecting every species to ensure accurate identification.

Gen. *Calanus* Leach.

1. *Calanus vulgaris* (Dana). Giesb. *F. u. Fl. Neap.* v. 19.

Very common in this collection, the size agreeing more with that given by Giesbrecht, viz. 2·5—2·8 mm., than with Brady's measurements, 3·1 m.

2. *C. vulgaris,* var. *plumosus.* Nov.

A most remarkable modification of the bristles of the tail, in which one or more has undergone more or less dichotomous branching, repeated in the sub-branches, the whole forming a sort of brush. There is great irregularity in the side affected, and in the number and position of the affected bristles, and it occurs in both males and females, with such frequency that quite ten per cent. of the whole number of examples are so affected. While the main stem of the bristle is feathered, this ceases at the commencement of the branching, and from this point the bristles are naked. (Plate XCVI. figs. 21 and 22.)

3. *Calanus Darwinii.* (Giesb. *loc. cit.*)

This species is also very common in this collection.

4. *Calanus Caroli* (Giesb.). (Giesb. 1892, *loc. cit.*)

The ♀ of this species is not known, only the ♂ being described by Giesbrecht, who remarks that it differs from *C. Darwinii* chiefly in the anatomy of the 5th foot, the differences being "constant in the length of the shears, the complicated anatomy of the 3rd joint of the exopodite, and the relative position of the proximal hook on the inner side of the long hook into which the marginal horn of the 2nd joint of the exopodite is transformed." While it may be questioned if this is a distinct species, I find in the Maldive collection several examples in which the 5th feet agree with Giesbrecht's description and drawings, and these variations from the type of *C. Darwinii* are constant. The animals are also a little less in size than *C. Darwinii.* See Plate XCVII. fig. 42.

♀. I have met with an adult Copepod which, while closely resembling the ♀ *C. Darwinii,* differs from it in the fact that the denticulation of the last joint of the exopodite of the 2nd feet (external margin) is absent, and also in the 3rd pair, and on the first basal joint of the 1st pair of feet possesses three or four very fine teeth. In other respects the animal agrees with *C. Darwinii,* but I suggest that it may be the ♀ of *C. Caroli.*

It must be admitted that it is very difficult to discriminate the one species from the other.

For the purpose of comparison the 5th feet of this species are shown in the fig. 42, Plate XCVII., along with the same organs of *C. vulgaris* and *C. Darwinii* (figs. 39 and 40).

5. *Calanus pauper*, Giesb. 1888, *Atti Acc. Lincei Rend.* Ser. 4, v. 4; 1892, *F. u. Fl. Neap.* v. 19.

This Copepod is only briefly described by Giesbrecht, and is therefore referred to here at greater length.

In the ♀, the head and 1st thoracic segment are united, the last thoracic segment has rounded margins. The anterior antennæ (25 joints) do not reach as far as the 2nd abdominal segment. The basal joints are thick, distally the antenna tapers; the bristles on Aa 2 and 3 are the longest, with the exception of the whip-like bristles on Aa 24. Aesthetasks are short but numerous. The mouth organs resemble those of *Calanus*. The posterior foot jaw has two dorsal recurved bristles and one terminal dorsal bristle.

The first pair of swimming feet is peculiar and characteristic and the same in both sexes (Plate XCVII. figs. 29 and 32). The second basal segment carries at the distal inner margin a modified spine of pyriform shape, with a tooth at the lower inner margin, is thick at the base, and distally tapers and ends in a whip-like bristle. In the second 5th pairs, the third joint of the exopodite is divided by the marginal spines in the following proportions respectively,

8 : 6; 2 : 1; 2 : 1; 2 : 1.

Proximally these segments are haired on the margins, but distally naked. The abdomen is of four segments, the furcal segments are nearly twice as long as broad, each carrying five bristles and an accessory bristle. The first basal joint of the 3rd and 4th feet is twice as long as broad. The bristles of the posterior antenna are not all naked, half of them being feathered on each side. The left 5th foot is slightly longer than the right, each foot consisting of a thin jointed exopodite and endopodite, the first basal joint of each being feathered on the inner margin.

The ♂ (Plate XCVII. figs. 31, 35) has a 24 or 25 jointed anterior antenna, the articulation between 1 and 2 clear, but not complete, the 24th separate from the 25th. The antenna is sharply bent at the 3rd segment, and on the anterior margin of this segment is a process carrying 4 long stout bristles, the only long bristles on the antenna. The posterior bristle of the posterior foot jaw (Plate XCVII. fig. 34) is short and feathered on both sides. The two branches of the mandible palp are nearly equal and resemble that of *C. gracilis*, except that the last joint of the exopodite carries no long bristle. The fifth pair of feet are characteristic. The left carries a peculiar hammer-like process, and is often twice flexed, once between the 2nd and 3rd joints, and again between the 1st and 2nd basals (Plate XCVII. figs. 30, 33). In many specimens this is the common post-mortem condition, in others the flexure is only at the terminal joint which is carried at right angles to the rest of the foot.

Size, ♀ 1—5 mm., ♂ 1—3 mm.

6. *Calanus minor*, Claus. 1863, *Cetochilus minor*, Freileb. Cop.; 1883, *C. valgus*, Brady, *Chall. Rep.*; 1892, *C. minor*, Giesbrecht, *F. u. Fl. Neap.* v. 14; 1894, *C. appressus*, Dahl, *Ver. d. Zool. Gesells.*

Giesbrecht was of the opinion that the *Calanus valgus* of Brady was identical with his *C. minor*. The drawing of the 5th feet of the ♂ as given by Brady does not agree with Giesbrecht's figure in small particulars, and especially in the much coarser dentation of the inner margins of the 1st basals in Brady's species, and in the spinulation of the last segments of the endopodites. The size of the latter species is also much greater than Giesbrecht's or the Maldive examples (Plate XCVII. fig. 37). The latter agree with Giesbrecht's species as to size and anatomy. The 5th feet of the ♂ do sometimes vary considerably from the normal type (see the figure), both as to the structure of the segments and denticulation of the basals. In the anomalous form figured there is no denticulation on the basal of the left side, that of the right side is comparatively coarse. On the left side there are only two joints in the endopodite (Plate XCVII. figs. 36, 38). Average size of the Maldive examples, ♀ 1·8—2·0; ♂ 1·7 mm. This species is not common in the Maldive collection and there are very few males.

7. *Calanus robustior* Giesb. (*F. u. Fl. Neap.* v. 19.)

There is a very puzzling resemblance between this species and *C. gracilis*, the distinction consisting in the much more swollen genital segment, and rounded projection of the first basal of the anterior foot jaw, and more robust build of the whole animal. Plate XCVI. figs. 5 and 6.

Gen. *Eucalanus* Dana.

8. *Eucalanus attenuatus* (Dana).

The examples from Mr Gardiner's collection average a size of 4 mm., and the species entirely replaces *E. elongatus* characteristic of the North Atlantic.

9. *Eucalanus subtenuis* (Giesb.).

Very common.

10. *Eucalanus pileatus* (Giesb.).

Common.

11. *Eucalanus crassus* (Giesb.).

Of very wide distribution, occurring frequently as far north as the Faroe Channel; this Copepod is found plentifully in the Maldive collection.

12. *Eucalanus mucronatus* (Giesb.).

Very common.

13. *Eucalanus subcrassus* (Giesb.).

14. *Eucalanus monachus* (Giesb.).

Gen. *Rhincalanus* Dana.

15. *Rhincalanus cornutus* (Dana).

16. *Rhincalanus nasutus* (Giesb.).

The former species almost entirely replaces *Rh. nasutus* in this collection, only one specimen of *Rh. nasutus* being discovered, while the former is extremely common.

Gen. *Paracalanus* (Boeck, 1864).

Two different species are common in the Maldive collections, viz. *P. parvus* and *P. aculeatus* Giesb.

It appears singular that with respect to such a common species as *P. parvus* there should be a divergence of opinion, but if Giesbrecht's figures are compared with those given by Sars (*Crust.* Norway) and by Scott (description of *P. parvus* in *Entomost. of the Gulf of Guinea*, p. 26 and Plate I.) a great dissimilarity is noticed, and it is evident that these are not the same species. As it is of importance to determine whether the species *P. parvus*, as found in the Indian Ocean, is really identical with that found in the northern temperate and boreal area, I have submitted the species to a detailed comparison with specimens taken in the Faroe Channel. There are such points of difference between the Mediterranean species of Giesbrecht and the Indian Ocean examples, and those described by Sars from Norway, and collected by me in the Faroe Channel, that they can scarcely be considered identical. The Northern and the Southern species form two distinct varieties.

17. *Paracalanus parvus*

This species as described and figured by Giesbrecht (*F. u. Fl. Neap.*) may be summarised as follows:

Size, 0·8—1 mm.; AA reaching the end of Ab 3: the innermost seta of the furca scarcely longer than the furcal segments; the first basals of the 2—4th pairs of feet with a slightly convex inner margin; the inner distal margin of the first ending in a short spine (in 3rd and 4th feet), the surface of the 1st basal of the 4th pair richly covered with spines and hairs; the last segment of the exopodite of the 4th four-and-a-half times as long as broad and the end saw only three-fourths the length of the segment; a corona of spines on the exop. of the 1st and 2nd feet, and 2 or 3 spines on the exop. 2 of the 2nd pair: the surfaces of the exop. 1 and 2 of the 3rd and of the end. 2 of the 4th feet naked, but of the 2nd and 3rd pairs with a few spines.

The species as described by Sars is "scarcely exceeding 1 mm." in length, and differs from Giesbrecht's species in the following points:

The 1st basals of the feet are longer in proportion to their breadth and their edges more parallel, especially is this the case in the 4th pair; there are no spines on the surfaces of the first basals of the 2nd, 3rd, and 4th pairs; the endop. 2 of the 2nd and 3rd feet have each a small corona of spines; the first and third joints of the expodite of the 1st pair have each an outer marginal seta. The exop. 3 of the 4th foot is nearly 5 times as long as broad.

The differences between the two forms, Mediterranean and Norwegian, are not great, but are constant, and while all the Indian Ocean examples which I have dissected approximate closely to that described by Giesbrecht, the Faroe Channel examples are more like the figures of Sars.

Paracalanus parvus (from the Faroe Channel), var. *borealis*.

Average size of ♀, 1·0—1·1 mm., AA reach to the end of the Ab 3; caudal segments twice as long as broad and as long as Ab 4; innermost seta very small; basals of the 3rd and 4th feet twice as long as broad, the inner margins rather convex, and with a few short spines

below the origin of the inner seta: more spines on the surface of the 3rd (basal) than in the 4th pair. 1st foot, with no outer marginal seta except the middle of the exop. 3. Outer margin of endop. 1 not ending in points, first basal of 4th feet, inner distal margin stumpy, but in 3rd feet with a little point. Endop. 2 of 2nd and 3rd feet with coronals of spines on the surface. 4th pair, basals without spines, except for 2 or 3 short points just below the inner seta, the exop. 3 five times as long as broad, the end saw three-fourths the length of the last segment, proximal outer edge with rather coarse teeth, and marginal spines very small.

P. parvus (from Indian Ocean), var. *Indicus*.

Average size, 0·8 mm. The basal of the 4th feet is very spiny, those of the 2nd and 3rd pairs also with spines on the margins and surfaces. The inner margins of the basals rather convex. The last joint of the exopodite of the 4th feet four times as long as broad, the end saw three-fourths the length of the segment, marginal spines small, proximal part of the segment with five teeth on the outer margin. Anterior antennæ reaching to the caudal segments.

In this variety the basal joints of the feet are more covered with spines, are broader in proportion to length, and the same is true of the last exopodite segment, and the animal is constantly of smaller size than the northern variety, and the anterior antennæ are longer.

	22	23	24	
Ant. ant., *P. parv.*	4	$3\frac{1}{2}$	$4\frac{1}{2}$	the last joint 1 broad, i.e. $4\frac{1}{2}$ times as long as broad,
P. acul.	6	6	9	„ „ 1·5 „ i.e. 6 times as long as broad;

the lower margins of the 10th—22nd segments are armed with a row of fine spines, absent in *P. parvus*.

The *Parac. parvus*, described and figured by Scott, from the Gulf of Guinea, is clearly not identical with the same species from the North.

The 4th pair of feet (Pl. XCVI. fig. 11) are those of *P. aculeatus*, Giesb. (in the proportions of the exop. 3, length of saw, spinulation of segments), as are also the abdomen (long inner bristle), and 5th feet (long outer bristle), and the size (1·12 mm.) and the longer last joint of the anterior antennae, which is nearly double the length of the penultimate joint.

Scott's *Paracal. pygmaeus*, though regarded by Giesbrecht as identical with Dahl's *P. crassirostris*, is probably the southern variety of *P. parvus*.

Pl. XCVI. figs. 7, 8, 9, 10, 11, 16.

18. *Paracalanus aculeatus* (Giesb.). Pl. XCVI. figs. 12, 13, 14, 15.

♀ 1·1 mm. long: the anterior antennæ reaching beyond the end of the furca, the last joint nearly 6 times as long as broad, and one-third longer than the penultimate joint: furcal segments two-thirds as broad as long, with innermost bristle about half as long as the next one. The basals of the 2nd—4th pairs of feet without spines. The fourth pair with the exopodite last segment four times as long as broad (a little broader proportionately than in *P. parv.*), the end saw as long as the segment; 13 or 14 rather coarse teeth on the proximal part of the outer margin, the distal margin ending externally in three much stouter spines than in *P. parvus*: a few spines on the surface of the exop. 2, the end. 2 with a corona of stout spines, the end. 3 with two rows of shorter spines. The end. 2 of the 3rd feet with a similar corona. 5th feet with the first segment more than twice as long as broad, the second segment

four times as long as broad, the inner terminal bristle nearly half as long as the outer one, a very short bristle on the external margin near the distal end.

This species is rather larger than *P. parvus*, especially differing from it in the length of the anterior antennæ, the innermost tail seta, and the characters especially of the fourth feet.

The ♂ of *Paracalanus parvus*, from the Maldives, shows the same spinulation of the basal segments of the feet as the ♀, only that this is even more marked, especially on the 3rd and 4th feet. The teeth of the edges of the last exopodite segment are coarser and larger, and the distal part of the margin of exop. 2 has teeth of the same character. The proportions of the exop. 3 of the 4th feet are the same as in the ♀, but the saw is longer, as long as the segment itself. The anterior antenna has many of the basal joints coalesced, the posterior foot-jaw has three very strong and well-feathered dorsal bristles, the anterior foot-jaw maxilla are greatly retrograded, the mandible palp well formed, but the masticating plate wanting. The 5th feet, of one long foot of the right side (often strongly flexed at the 2nd basal) and a very short two-jointed left foot, shows no essential differences in the Northern and Indian Ocean varieties.

Most examples of *P. parvus*, var. *Indicus*, have the tail bristles entirely pigmented a bright red.

19. *Paracalanus aculeatus*, var. *plumulosus*.

As in some allied genera, there are some examples of *Paracalanus* in this collection in which the tail setae have undergone the dichotomous branching before mentioned. From the size (1·2 m.), the long anterior antennæ (longer than the whole animal), denticulation of the lower margins of many of the antennal segments, size of the furcal segments, basals of the 2nd—4th feet without spines, and terminal saw of the 4th foot equal in length to the last exopodite segment, it is a variety of *P. aculeatus*. Pl. XCVI. fig. 23.

Gen. *Clausocalanus* Giesbrecht.

20. *Clausocalanus arcuicornis* (Dana).

21. *Clausocalanus furcatus* (Giesb. = *Drepanopus furc.* of Brady).

The former is the more common in this collection and of average size, 1·1—1·3 mm., rather smaller than the examples described by Giesbrecht.

Gen. *Calocalanus* Giesbrecht.

22. *Calocalanus pavo* (Dana).

23. *Calocalanus pavo*, var.

Apparently similar to the type species, but differing in the dichotomous branching of the tail setae, and the possession of a row of very stiff spine-like bristles on the external margin of the 1st joint of the exopodites of the 3rd feet.

24. *Calocalanus plumulosus* (Claus).

25. *Calocalanus styliremis* (Giesb.).

Gen. *Acrocalanus*, Giesb.

1888, *Atti Acc. Lincei Rend.* Ser. 4; 1892, *Fauna u. Fl. Neap.* v. 19.

The genus is related to *Paracalanus*, but the anatomy of the swimming feet is at once distinctive. The outer margins of the last joint of the exopodites are divided by the

external spines into portions more nearly equal and the proximal part is never double the length of the distal; the outer edges of the exopodites are toothed, in the 2nd pair in all joints, in the 3rd pair proximally only, and in the 4th pair strongly in the proximal portion and with finer teeth in the distal portion; the terminal bristle of the 3rd pair is never longer than the last joint of the exopodite; the end joint of the endopodite of the first pair carries 5, and the same joint (the third) of the endopodite of the second pair carries only 6 bristles. In the ♀ the 5th pair of feet is usually entirely absent, and represented only by one or a pair of short and easily overlooked stumps but a 5th foot occurs in some ♀s and is small, simple, and exists only on the left side, very similar to that of the ♂ but in the latter the foot is much longer, though only occurring on the left side. The ♂ very closely resembles the ♀, but since the anal segment is always the largest and showing only partial segmentation from the preceding segment, and the mouth organs are usually very similar to those of the ♀, and not retrograded as is the case in allied genera (viz. *Paracalanus*), I think it must be concluded that none of the very numerous male examples found are really mature except in the species *Acroc. Gardineri*. I have found a few ♀s apparently of *Acrocal. longicornis, Acrocalanus gracilis* and of *Acroc. gibber* with a small left 5th foot, so it appears that a 5th foot is sometimes present in both sexes.

Giesbrecht originally described four species of *Acrocalanus*.

1. *A. longicornis*, in which the anterior antennae are longer than the whole body by 5 joints.

2. *A. monachus*, in which the head is produced, so as to be almost quadrate in shape.

3. *A. gibber*, with oval-shaped head, but the back strongly swollen into a hump.

4. *A. gracilis*, with oval-shaped head, without any dorsal hump.

Giesbrecht cast some doubt upon the validity of the specific distinction between *A. gibber* and *A. gracilis* ("nicht ganz zweiffellos" Giesb. *F. u. Fl.* p. 175), but he remarked upon its relationship to *A. longicornis* in the fact that in both species there was a partial segmentation of the head from the thorax. The observation and dissection of a great number of specimens has shown the truth of Giesbrecht's deduction, and there can be no doubt that they are distinct species.

In *A. longicornis* and *A. gibber* the partial but distinct line of segmentation between Ce. and Th. 1 is always present, as well as a strong dorsal hump.

In *A. monachus* and *A. gracilis* there is never any line of segmentation between Ce. and Th. 1, and never any dorsal hump, the back being in each regularly rounded. In *monachus*, however, the front of the head is produced, giving an appearance of a monk's hood, while in *gracilis* it forms an even curve. The fifth species, to which I have given the name *Acrocal. Gardineri*, presents some peculiarities but possesses so many of the generic characters of the genus *Acrocalanus* that it must be included in this genus.

26. *Acrocalanus longicornis* (Giesb.).

The ♀ is from 1·14—1·2 mm. and possesses the characters of the genus, but is at once distinguished from other species by the great length of the anterior antennæ, which reach beyond the end of the furca by 5 joints. The front of the head is rounded, but there is a strong dorsal hump or swelling on the 1st cephalothoracic segment about on a level with

the mouth. There is a distinct attempt at articulation between the head and 1st thoracic segment, and the 5th (last) thoracic segment is also partially divided.

The abdomen of 4 segments has the genital segment broader than long, and as large as Ab. 2 and 3, laterally swollen and protuberant ventrally, the largest and longest joint of the abdomen, the anal segment, is nearly twice as long as the third, the furcal segments twice as long as broad and symmetrical. The innermost tail bristle is short, the outermost still shorter.

In the posterior antenna the exopodite is a little shorter than the endopodite, the 7th (last joint) longer than exop. 1 or exop. 2 and than exop. 2—6. The end. 1 is nearly twice as long as end. 2. The anterior foot-jaw has the 4th and 5th lobes larger than the others, the endopodite short, but distinctly 3 segmented, the hook bristle on lobe 4 longer and thicker than that on lobe 5. The posterior foot-jaw has a broad first basal, with strong hump on the distal inner margin, the 2nd basal nearly three times as long as broad, the endopodite as long as the 1st basal, and longer than the second basal. The dorsal bristle of the 4th joint (exop.) is short (= the dorsal bristle of exop. 5). Exop. 5 has 4 bristles, the middle one the longest, and only the posterior bristle feathered. Only the proximal bristles of the 3rd and 4th joints are feathered; the two proximal bristles of the 2nd joint, and all three of the 1st joint are feathered. All the bristles of the 1st and 2nd basals are feathered.

The swimming feet are segmented as indicated in the generic characters. The 1st basal of the 1st pair is strongly convex on the inner margin, and without inner bristle, the surface covered with short prickles, haired on the inner margin and with a few stiff short bristles on the proximal part of the outer margin.

The 2nd basal is also strongly convex on the inner margin with a strong coronal of spines distally, and short stiff hairs on the inner margin with a long inner bristle.

The basals of the other feet are less convex than in the first pair. The first joints of both exop. and end. are small. In the 2nd pair the external margin of exop. 1 has a corona of spines distally and externally, exop. 2 has 4 or 5 sharp teeth in the middle of the outer edge, and the spine of the distal outer margin is comparatively long, the surface is distally armed with a corona of spines. The last joint of the exopodite is divided into two nearly equal portions by the marginal spine, and both proximal and distal portions are armed with marginal teeth. Both the basals and the exop. 3 are armed on the surface with short prickles.

The 3rd feet have the external distal spine of exop. 2 large, with shorter spines internal and external to it. The whole outer margin of exop. 2 and the distal only of exop. 3 is armed with teeth. The surfaces of the segments of the exop. are armed with spines, those in exop. 2 in two rows, and in exop. 3 with a number of short prickles. The surface of end. 2 has a series of long sharp spines on the surface, and the end. 3 a few short surface spines. The terminal saw of this foot is only about three-quarters the length of exop. 3. The basal joints, especially the first, are armed with coronals of spines on the distal surface and smaller spines proximally.

The 4th feet in general resemble the 3rd, but are longer. The exop. 3 has coarse teeth along the proximal external margin, and along the distal margin a few fine teeth only. The segment is divided, proximal : distal :: $9\frac{1}{2}$: $8\frac{1}{2}$. See Pl. XCVII. figs. 1, 6, 11, 12, 13, 22.

The ♂ with a length of ·9 mm., of which several examples occurred resembling the figure, has a 5th foot only on the left side, consisting of 4 segments with relative proportionate lengths of $5 : 2\frac{1}{4} : 3 : 6$; the distal and largest joint with 3 very rudimentary marginal spines and one terminal bristle five-sixths as long as the last segment. This foot is as long as the abdomen, and nearly as long as both basals of the two proximal endopodite joints of the 4th foot. The head is only partially segmented from the 1st thoracic segment, and the large 4th abdominal segment is only partially and dorsally segmented. The mouth organs are not retrograded, and these and the 1st to the 4th pair of feet resemble the same organs in the female. Probably this is a not quite mature ♂, but the single long left foot is more robustly built than the same (rudimentary) structure occurring in any adult female. Pl. XCVII. figs. 23, 24.

A ♀ of this species, of length 1·1 mm., possessing an abdomen with distinct genital swellings, with anterior antennæ exactly resembling *Ac. longicornis*, and with the 1—4th pairs of feet also exactly the same, had one (left) 5th foot, of 4 segments, the relative proportions of which were $3 : 2 : 2\frac{1}{2} : 3$ (distal), with a fine short terminal bristle only half as long as the end joint. The whole foot was very short and only as long as the 1st basal joint of the 4th foot. The appearance of the abdomen and of the genital segment so clearly indicate the ♀ sex of this animal, that it must be concluded that the ♀ *Acrocal. longicornis* occasionally has a rudimentry left 5th foot.

27. *Acrocalanus monachus* (Giesb.).

This species is very briefly described by Giesbrecht. Many examples occurred in Mr Gardiner's collection, and agreed in length with the measurements given by Giesbrecht, viz. ·91—·92 mm. It is a very much smaller animal than any of the other species, and is at once recognisable by the peculiar shape of the head, which is produced anteriorly, and forms a sort of hood. In the dorsal aspect the cephalon is very narrow as compared with the rest of the cephalothorax. There is in this species no trace of division of the head and Th. 1, and very little dorsal hump. The anterior antennæ reach beyond the end of the furca only a little, at most two or three joints. Essentially there is no difference in the structure of mouth organs or feet, from *Ac. longicornis*, except that the marginal teeth of the exop. 3 are coarser in structure, the number of marginal and superficial spines and teeth on the exopodites of the 2nd and 3rd feet is greater, and the teeth are rather coarser. The distal margin of the exop. 3 of the 4th foot has 10 rather coarse teeth of the same character as the 16 teeth on the proximal margin of the same foot. In the posterior foot-jaw the bristles of the 1st and 2nd basal and the first joint of the endopodite are feathered. All the rest are naked. The 1st joint of the endopodite of the posterior antenna has a more pronounced external swelling than in the type species. Otherwise there appears to be little difference in the structure of the appendages from those of *Ac. longicornis*. See Pl. XCVII. fig. 49.

♂s of this species occurred in this collection, but as in the case of the previously described species, none of them were probably mature—one however is figured on Plate XCVII., with one fifth foot only on the left side reaching beyond the distal end of the third abdominal segment. The anal segment, which is nearly as long as the proximal three abdominal segments, and the unretrograded condition of the oral organs are probable indications of sexual immaturity. See Pl. XCVII. figs. 27, 28.

28. *Acrocalanus gibber* (Giesb.).

The animal is comparatively small (♀ 0·93—1 mm. in length), and is more compact than the other species. The head is rounded anteriorly and has a strong dorsal hump, and there is a distinct though partial indication of segmentation between the head and 1st thoracic segment. The greatest breadth of the thorax is to the length in the proportion of $5\frac{1}{2} : 13$; the proportion of the cephalothorax to abdomen is 14 : 4. The genital segment is the largest, with very prominent ventral swelling. Ab. 2 and 3 are small, the anal segment larger than either; the furca, as in other species, twice as long as broad.

The anterior antennæ do not reach the end of the abdomen. The mouth parts resemble the other species of the genus, but the outer tooth of the mandible is perhaps more set back and more below the level of the other teeth, and there is a wider space between this and the next inner tooth.

The swimming feet have the general characters of the genus, very closely resembling *Ac. longicornis*, and not so heavily armed with surface spines as *Ac. monachus*. The marginal teeth of the 2nd, 3rd and 4th feet (exop. 3) are very coarse and strong, and the distal part of the 3rd exop. of the 4th feet is also armed with strong teeth, instead of the fine teeth of *Ac. longicornis*.

The first impression given by the general appearance of this animal is that it is a smaller example of *Ac. longicornis*, but the examination of a large number of examples has convinced me that Giesbrecht was quite correct in assigning to it a different specific rank. Fully adult females show constantly comparatively shorter anterior antennae and segmentation of the 1st cephalothoracic segment, a more compact and robust body and smaller size, as well as coarser teeth on the margins of the feet segments. Pl. XCVII. fig. 38.

Several apparently immature males occurred in this collection.

29. *Acrocalanus gracilis* (Giesb.).

This species is at once distinguished from the others by its larger size, anterior antennae only a little extending beyond the end of the furca (by about 2 joints), rounded shape of the head, continuous curve of the 1st thoracic segment without any dorsal hump, and with no trace of segmentation of the head and 1st thoracic segment. The average size of the females is 1·3—1·4 mm.; the abdomen is one-third the length of the cephalothorax. Of the abdominal segments the genital is not as proportionately large as in the other kinds; and the furcal segments are not twice as long as broad. The mandibles and posterior antennæ resemble those of *Ac. monachus*, the anterior foot-jaw also, except that there are short stiff marginal bristles on the 3rd, 4th and 5th lobes, and a stout dorsal feathered bristle on the margin of the second basal joint. The posterior foot-jaw resembles that of *monachus*, but the bristles of the 1st basal are stouter and longer.

In the 1st feet the second basal is more convex than in *monachus*. The marginal teeth of the last joint of the exopodite of the 2nd feet are strong (6 proximal, 5 rather shorter, distal). The 3rd foot is very similar to that of *Ac. longicornis*, the marginal teeth of the exopodite the same, but a few more spines on the first basal joint. The 1st basal of the 4th feet is more convex than in *longicornis*, and there are more spines distally; there are two rows of long spines on the exop. 2, and a few scattered spines on exop. 3; none on the surfaces of exop. 1, 2 and 3, and none on the second basal. The marginal teeth of exop. 3 are on the proximal portion more numerous and smaller than on the distal part. The 5th

feet are absent, but the short stumps, which in this genus represent the rudiments of feet, are in this species a little larger than in the others.

Just as in *Acrocalanus longicornis*, I have met with occasional examples in this species of females with a rudimentary left 5th foot, of three segments, the whole foot not as long as the first basal joint of the 4th pair. These examples agree entirely with the type species of *Ac. gracilis* and are undoubted females, the genital segment being well developed with prominent genital orifices. See Pl. XCVII. figs. 2, 7.

The ♂ of *Acrocalanus gracilis* is of size of 1·09—1·14 mm.; the cephalothorax ·83 mm., the abd. ·30 mm.; the head is rounded, there is no dorsal hump, but, as in other males of this genus, there is partial segmentation of the cephalon and 1st thoracic segment. The anterior antennæ reach beyond the furca by about 2 joints, and are of 25 distinct segments. The abdomen consists of 5 segments, the 4th and anal not however clearly separated throughout, the anal segment the longest, the furcal segments are larger than broad (as 5 : 3), and rather divergent.

The feet resemble those of the female, but the external spines (distal spine of exop. 2 of 2nd feet, marginal spine of exop. 3 of the 3rd joint) are the largest. Otherwise there is no difference essentially in the feet of the two sexes. The 5th pair is represented as in other ♂s of this genus by one (left) foot, of 4 segments, the distal the largest, ending at the inner distal margin in a short curved spine; there are two rudimentary spines on the outer margin of this segment, and the marginal terminal spine of the end segment is much shorter than the bristle of the ♂ of *Ac. longicornis*. The ♂ of this species is distinguished from that of *monachus* by the shape of the head, and from those of *longicornis* and *gibber* by the absence of the dorsal hump. Probably however the ♂ described is not quite mature. Pl. XCVII. figs. 25, 26.

30. *Acrocalanus Gardineri*, nov.

Many examples occurred in Mr Gardiner's collection of an adult ♂ of this genus.

♂, length 1·25 mm. (cephalothorax ·9 mm., abd. ·3 mm.); the abdomen is therefore only one-third the length of the cephalothorax. The latter comprises five segments. The head is oval, ending in a 2-pointed rostrum. The curve of the back is continuous, and there is no dorsal hump. The head and 1st thoracic segment are united. In the abdomen, distinctly of 5 segments, the 2nd segment is twice as long as the 1st, and the anal a little longer than the furcal segments. The latter are longer than broad (as 5 : 3), each with four bristles, and the segments very divergent. The anterior antennæ do not reach much beyond the end of the trunk, the basal joints are very thick and many joints are coalesced, 18 only being clearly marked.

The posterior antennæ have an exopodite with 5 marginal bristles, but the last joint has no bristles on the end of the segment, appearing only as a short stump; the last joint of the endopodite bears distally 6 + 5 bristles. Both rami are nearly equal in length.

The mandibles have a well-developed palp, but no trace of a masticatory plate, the exopodite of five segments, the endopodite of two, the 1st longer than the 2nd.

The maxilla is retrograded. The exopodite is well developed, but the inner lobes are rudimentary and without bristles. The endopodite has only two weak bristles, and the 1st outer lobe 5 long bristles.

The anterior foot-jaw is reduced to a small stump. The posterior foot-jaw, on the contrary, is well developed. The 1st basal is a little longer than the 2nd, and the latter is as long as the endopodite (proportions B 1 : B 2 : End. :: 8·5 : 6·5 : 6·5). There is a long feathered bristle dorsally on exop. 4 (as long as the whole foot-jaw), a shorter and thinner dorsal bristle on exop. 5, and the dorsal terminal bristle of this segment is the shortest of the three recurved dorsal bristles. The ventral bristles of this limb are all short, and the proximal ones feathered.

The 1st feet have the end joint of the endopodite with 5 bristles, and the proximal portion of the exop. 3 is toothed with rather coarse teeth.

The 2nd feet have the exop. 1, 2 and 3 each ending in a sharp spine distally on the outer margin: the last joint has 6 bristles, the last joint of the exopodite is divided by the marginal spine into two portions, proximal and distal respectively, in proportions of 8 : 6, and the terminal scalpel-shaped bristle has an undentated edge, rather curved tip, and is shorter than the end segment.

The 3rd feet have the last joint of the exopodite divided in the proportion of 9 : 8, and both proximal and distal margins (externally) armed with coarse teeth, rather finer in the distal portion. The terminal bristle is three-fourths the length of the segment.

The 4th feet have the external margin of exop. 3 divided in proportions of 8 (distal) to 11 (proximal), both portions with strong teeth.

The 5th foot (left side only) is of 5 distinct joints: the 1st basal a little shorter than the 2nd, but the latter is capable of a considerable degree of flexion, and, in nearly all examples seen, this joint, along with the three terminal joints, is flexed at right angles to the 1st basal. All the segments are of nearly equal length, the last segment bearing a short terminal bristle and a rudimentary spine on the external margin, and the penultimate segment ending at the outer distal margin in a short strong spine.

With strongly marked sexual characters it does not seem possible to identify the animal with other known species of *Acrocalanus*, especially as it differs greatly from other though possibly immature males met with. The 2nd—4th feet have the endopodites and basals especially spinous. See Pl. XCVII. figs. 5, 10, 14, 15, 16, 17, 18, 19, 20, 21.

[Since writing the above I have compared it with the description given by Prof. Cleve of his new Malayan species *Ac. pediger*. They appear to be distinct. The 5th feet of the latter alone are quite sufficient to prove this, being, in the ♂ of *pediger*, a pair, the right foot half the length of the left.]

Gen. *Bradyidius* Giesb.

31. *Bradyidius armatus*, ♀. Giesb. *Zool. Anz.* v. 40. *Tierreich*, p. 32. *Pseudocal. armat.* Brady, *Cop. Brit. Isles*. *Bradyanus*, Vanhöffen, *Zool. Anz.* v. 20. *Undinopsis*, Sars, *Crustacea of Norway*.

The occurrence of this copepod in Mr Gardiner's collection is remarkable, for it has as yet been known only as a species of strict northern habit. A very careful comparison of the only two examples from the Maldives with those taken by me in the Faroe Channel and in the neighbourhood of the Shetland Islands, reveals no essential points of difference. The northern species is about 2·4 mm. in length, those from the Maldives are only 1·2 mm. in length. Beyond this difference in size, and the fact that the terminal saws of the feet are

armed with teeth, which are fewer in number and rather coarser in structure, there is no essential difference between the specimens from the two localities. These are not, however, points of sufficient specific importance to justify creating a new species. Should this, however, be thought desirable the name *Bradyidius tropicus* might be suggested. While at Naples in April, 1902, Dr Giesbrecht showed me an example of *Bradyidius* taken in the Mediterranean, which I compared with my Faroe Channel specimens, with which it was identical, except that the saws of the swimming feet were armed with fewer teeth. A connecting link is thus formed between the extreme North and the Indian Ocean, and it is probable that the distribution of this copepod may be found eventually to be much wider than has been thought, especially when captures are made with the tow-net near the bottom of the sea; for it is distinctly, as Sars has pointed out (*Crust. of Norway*), a bottom species. I find it occur not uncommonly in samples taken by scraping the bottom with a specially devised triangular-shaped net frame, while only occasionally in captures made by the tow-nets which have not scraped the bed of the sea.

Gen. *Euchirella* Giesb.

32. *Euchirella bella*, var. *Indica* (Giesb.). 1888, *Atti Acc. Lincei Rend.* Ser. 4; 1892, *F. u. Fl. Neap.* v. 19.

Several examples of this species occurred in Mr Gardiner's collection. The average size of the fully developed ♀ was 3·5 mm. The cephalothorax is nearly 5 times as long as the short thick abdomen. The broad head carries in front a strong one-pointed rostrum. The last thoracic segment has rounded edges. Of the swimming feet, the 1st has a one-jointed endopodite and two-jointed exop.; the 2nd pair a one-jointed endopodite; the 3rd and 4th pairs 3-jointed endopodites; and the 2nd, 3rd and 4th pairs 3-jointed exopodites. The first basal joint of the 4th pair have on the inner margin 4 stout spines, and this character differentiates this 4th pair from the corresponding foot of any other *Euchirella*. The inner branch of the posterior antennæ is very rudimentary, not more than a quarter of the length of the exopodite. The latter carries distally 5 + 5 bristles. In other respects the animal agrees with *Euchirella bella* as described by Giesbrecht. The description of this species is, however, not very detailed, and I do not feel sure that the Maldive examples agree entirely with Giesbrecht's species. The proportion of the abdomen to the cephalothorax is perhaps a little different (Ct. = 3·03 mm., Ab. = ·62); the bristles of the endopodite of the posterior antennæ differ (being 5 + 5, instead of 6 + 5 of *E. bella*); and the character of the spines of the 4th feet. These do not spring directly from the margin of the 1st basal joint, but are at the distal end of a short stalk which springs from the joint (see the figure).

The maxilla, though in general resembling that of *E. messinensis*, has an exopodite with only 9 bristles instead of 11.

The 2nd pair of feet have the external spines of the second joint of the exopodite much longer and thicker than the spines of the 3rd joint, and the 1st and 2nd basals of the 1st pair have on the inner margins each a tuft of long and rather broad hairs, midway in character between hairs and the lamellar processes of a *Gaidius*. See Pl. XCVII. figs. 17, 18, 19, 20.

I have met with one ♂ specimen in which the 5th feet are evidently rudimentary, and the animal is therefore only a young example. The male of this species is hitherto unknown.

In one example, evidently that of a young female, there is the curious condition of the tail bristles found in *Calanus valgus* and *Paracalanus aculeatus*. All the hairs of the right side are branched in a manner similar to those previously described.

The process of the 4th foot and the bristling of the posterior antennæ may be sufficient to justify this animal as a different species from Giesbrecht's *E. bella*.

Gen. *Euchæta* (Philippi).

Three species of *Euchæta* are common in the Maldive collections, two of which may be referred to recognised species, while the third does not appear to entirely agree with any described species. As in other Euchætas the most constant characters in the females are to be found in the shape and outgrowths of the genital segment, and the structure of the 1st and 2nd pairs of feet.

33. *Euchæta marina* (Prestand, 1833). Giesb. *Fauna u. Fl. Neap.*; Claus, *Freileb. Cop.*

This species in the Maldive Archipelago is not quite identical with the Mediterranean species described by Giesbrecht, but the differences are only such as to distinguish it as a variety. See Pl. C. figs. 7, 8, 10, 11, 17, 18.

♀. Size 3·3 m.: last thoracic segment with rounded margins, with short bunches of hairs, cephalothorax 2½ times as long as the abdomen, the latter having the genital segment not quite as long as the two succeeding segments; the anterior antennæ in length reaching a little further than the end of the genital segment.

The genital segment is without any dorsal hump, but not symmetrical, being more swollen on the right side, but this swelling does not occupy the whole length of the segment. The genital opening occupies the upper half of the segment and is guarded by two vulvar flaps, of which that on the right side extends rather lower than that of the left side.

The exopodite of the first foot is concave above, convex below on its external margin, the distal seta of the first joint about half as long as the second joint.

In the second pair the external marginal spine of the 2nd exopodite segment reaches to the base or a little beyond it of the first external spine of the 3rd joint, the 2nd spine of this segment is long with an outward bend, and reaches nearly to the end of the segment.

The posterior antenna has a prominent bulging of the external margin of the 1st joint of the exopodite; the outer margin of the first basal of the anterior foot-jaw is rather convex, the maxilla has a first outer lobe with four long and one short (5 in all) bristles, the endopodite 2nd joint with 4 bristles.

The whole of the chitin covering of the thorax with the exception of the fore part of the head is densely covered with short prickles, long hairs in bunches on the last segment, dorsally and marginally, and bunches of long hairs on the abdominal segments.

The adult females have egg-sacs attached with 10—18 eggs.

The 5th feet of the ♂ present only slight differences from those figured by Giesbrecht (*F. u. Fl. Neap.* v. 19), which may be seen on comparing the two figures. See Pl. C. figs. 19, 20.

The ♀ differs from Giesbrecht's species chiefly in the greater length of the anterior body in proportion to the abdomen, and shorter length of the anterior antennæ, and the denser covering of the chitin with small spines or prickles.

34. *E. marina*, var. Pl. C. fig. 9.

Size 3·3 mm. Cephalothorax 2½ times as long as the abdomen. Anterior antennæ reaching about the middle of the genital segment. The latter as long as the two succeeding joints, swollen on both sides but mostly on the right, without dorsal swelling, not possessing the distinct vulvar flap of *E. marina*, and carrying an egg-sac with 16—18 eggs. Oral organs like *E. marina*. 1st and 2nd pairs of feet like *marina* except that the marginal spine of the exopodite is rather longer, reaching the end of the spine above.

Densely clothed with long hairs over the abdominal segments and margins of the last thoracic segment dorsally, and the chitin very prickly.

35. *Euchæta concinna* (Dana). Giesb. *Fauna u. Fl. Neap.* v. 19.

♀, 2·75—3·0 mm. long. Cephalothorax more than twice as long as the abdomen, the former nearly three times as wide as long, the latter 4½ times.

Anterior antennæ not reaching to the end of the 2nd abdominal segment. The genital segment longer than the three succeeding segments, the four tail bristles of equal length, the two long ones much thicker than the others. The last thoracic segment prolonged on each side, but on the left much more than the opposite side and ending in a blunt rounded process. The thorax is not covered with such dense or prominent prickles as in the last species, and there are only a few hairs on the last thoracic segment; the abdomen is covered with short prickles, and each segment is haired.

The genital segment is characteristic, and possesses a hump on the dorsal surface, a strongly projecting flap on the right side, the lower margin of which is armed with short blunt spines, and a larger and more ventrally projecting flap on the right side.

The posterior antenna has the first segment of the exopodite with an external bulge as in *E. marina*, and the shape of the basals of the anterior foot-jaw is the same as in this species. The posterior foot-jaw in general resembles that of *E. marina*. The first outer lobe of the maxilla possesses 6 bristles instead of 5 as in *E. marina*.

The feet are characteristic. In the 2nd pair, the external marginal spine of the 2nd exopodite joint is the longest of all the marginal spines, reaching the tip of the spine above it. The two proximal marginal spines of the exop. 3 are of similar size, the segment is divided by the deeply incurved cleft into two equal portions.

The external margin of the exopodite of the 1st pair is rather concave, the bristle on the 1st joint and very thin, and does not reach the distal margin of the last segment. See Pl. C. figs. 1, 2, 3, 4, 5, 6.

There is little doubt that this species is identical with the *E. concinna* of Dana and with Giesbrecht's description.

36. *Euchæta indica* (nov. sp.).

♀, 2·31 mm. long, the cephalothorax 2⅓ times as long as the abdomen. The division of the head from the thorax is in this species scarcely distinguishable, the last segment of the thorax possesses unequal rounded margins, a rather prominent ventral projection on

the right side, and the whole thorax, except the front part of the head, is densely covered with small prickles.

The anterior antennæ are longer than the thorax, reaching about the end of the genital segment. The latter is as long as the next succeeding segments and about half the furca, and is asymmetrical, being more swollen on the right side, with a slight rounded protuberance of this side at the distal margin. The genital opening is protected by a ridge of chitin above and below, and a pair of prominent cushions.

There is only very slight swelling of the upper part of this segment on the left side, and no dorsal swelling. The abdomen is covered with short hairs.

The oral organs are like those of *E. marina*, the maxilla having a first outer lobe with 5 bristles, the proximal the longest, the distal the shortest; the anterior foot-jaw has the basals scarcely convex.

The 1st pair of feet have the external margin of the exopodite nearly straight, the spine of exop. 1 as long as the terminal segment. The 2nd pair have the external marginal spine of exop. 1 stout and reaching beyond the base of the spine above it: the second marginal spine of exop. 3 as long as the distal portion of this segment.

The species is therefore very different from *E. marina*, in the proportions of the genital segment and its structure, and especially in the anatomy of the second pair of feet, in the proportionate length of the antenna &c., and from *E. concinna* in the form of the genital segment and the structure of the 2nd pair of feet especially.

A good many females were found, each bearing an egg-sac with 6—10 eggs. Pl. C. figs. 12, 13, 14, 15, 16.

Gen. *Phaenna* Cls.

37. *Phaenna spinifera* (Claus).

Only very few examples of *Phaenna spinifera* (Claus) occurred in this collection and these were not quite adult females for the most part, only one, of a length of 1·9 mm., being mature. It differed in no way from the Mediterranean species. Probably it is not of frequent occurrence in the Indian Ocean.

Gen. *Scolecithrix* Brady.

38. *Scolecithrix danae* (Lubbock). *Tr. Ent. Soc. London*, Vol. IV. p. 15.

Identical with the Mediterranean and Atlantic species, it occurs in considerable abundance in this collection.

Gen. *Mecynocera* Thompson.

39. *Mecynocera clausi* (Thompson). *Journ. Linn. Soc.* Vol. XX. 1888.

This extremely characteristic species, which appears to be of world-wide distribution (Mediterranean, Atlantic and Pacific Oceans between 30° N. and 3° S.[1], and lately recorded by the writer from the neighbourhood of the Irish coast in lat. 52° N.), occurs only sparingly (two or three examples only) in this collection. In the report upon the Ceylon Copepoda

[1] Giesb. and Schmeil, *Das Tierreich*, p. 23.

by Thompson and Scott[1], it is mentioned as occurring "throughout the Indian Ocean," and it is evident that its distribution is of much greater range than hitherto supposed. The Maldive examples are identical with the northern.

Gen. *Haloptilus* Giesb.

40. *Haloptilus longicornis* (Claus).

Of the two species of this genus which occur in this collection, the above is of wide distribution, occurring in the Faroe Channel and Atlantic, and West of Ireland (Wolfenden), the Mediterranean and Pacific Ocean (Giesbrecht), and now recorded from the Indian Ocean. It is rather singular that it should not have been recorded in the list of Ceylon Copepoda of Thompson and Scott, considering its very frequent occurrence in the Maldive collection.

The animal is distinguished by its very long anterior antennæ, which are longer by the last 9 or 10 segments than the whole body, and the last segment of which is invariably, in all the specimens I have seen from the Atlantic and Indian Oceans, coloured a bright chlorophyll green; by the median papilla instead of a pointed process of the head, and by the anatomy of the maxilla (endopodite of 2 segments bearing 5 bristles, exopodite with 6 bristles). The size of the adult female, 2·2 mm., agrees with that of the Mediterranean and Atlantic examples.

In the *Challenger Report* Brady very briefly mentioned a species which he named *H. orientalis*. The description however occupied only four lines of text, but a comparison of the six figures given in the Plates IX. and X. with some of the Maldive specimens leads me to the conclusion to which Giesbrecht (*F. u. Fl. Neap.*) has already arrived, that Brady's species is only the young and immature form of *H. longicornis* (Claus). In many of these examples there occurs (as in Brady's species) a pair of 5th feet in which the endopodites and exopodites are respectively only of two segments, but which animals differ in no respect except in size, and the apparently immature nature of the genital segment, from other and larger mature specimens of *H. longicornis* which occur in the same gatherings. *H. longicornis* of the Maldives does not differ in any essential particulars from the more northern species.

41. *H. spiniceps* (Giesb.). *F. u. Fl. Neap.* Vol. XIX. p. 384.

Two adult and one immature females of this beautiful species occurred in Mr Gardiner's collection.

The essential differences between the Maldive and the Mediterranean examples are in the structure of the posterior antennæ and the 3 bristles in place of 2 of the maxillary endopodite. In all other particulars the species are identical. See Pl. XCVI. fig. 45.

Gen. *Pleuromamma* Giesb.

42. *Pleuromamma abdominalis* (Lubbock). Giesb. *Fauna u. Fl. Neap.* Vol. XIX.

The species shows no essential difference from the Mediterranean examples described by Giesbrecht (*F. u. Fl.* Vol. XIX.). See Pl. XCVI. figs. 28, 29, 30.

43. *Pleuromamma indica* (nov. sp.).

Very closely resembles *Pl. abdominalis*, but is constantly smaller in size, the largest examples only 2·5 mm. in length (varying between 2·3—2·5 mm.). The cephalothorax is nearly $2\frac{1}{3}$rd times as long as the abdomen (Ct. 1·65 mm., Abd. ·75 mm.).

All the female examples referred to have a well developed genital segment ventrally enlarged, and with deeply black pigmented vulvar papilla. This segment is as long as the two succeeding segments and half the furcal, thus much larger than in *Pl. abdominalis*. The furcal segments are twice as long as broad.

The anterior antennæ possess short teeth only on the 1st and 2nd (coalesced) joint, and also on the 4th, 5th and 6th segments. These teeth are however much smaller than those of *Pl. abdominalis*, and no recurved tooth is ever present. The 17th joint is longer than the 16th (the reverse of *Pl. abdominalis*), the 7th is not so distinctly coalesced with the 8th, and the 9th and 10th are distinctly separated.

The posterior antennæ, maxillæ, mandibles and anterior foot-jaws resemble the same organs in *Pl. abdominalis*, the posterior foot-jaw resembles that of *Pl. robusta*.

The swimming feet resemble those of *Pl. abdominalis*, only that the cleft distally on the exop. 1 of the 3rd pair and the thumb-like extension of the joint are comparatively larger; the endopodite of the 4th pair has the first two segments without the bulging of the outer margins, and with nearly parallel margins.

The head is without process in front, and the pigment ocellus is placed either on the right or the left side.

The species therefore differ from *Pl. abdominalis*,

(1) in the constantly smaller size of adult females;

(2) in the absence of recurved teeth on the anterior antennæ and longer 17th joint, and less fusion of the basal joints;

(3) in small differences in the structure of the feet.

The ♂ of this species is 2·0—2·05 mm. in length, the pigment spot is on the left side, and the geniculating antenna always on the right side. In the latter the first and second joints are coalesced, the 7th, 8th and 9th, the 12th and 13th, the 17th joint (i.e. the one before the elbow joint) is only half the length of the next, and the 24th is coalesced with the 25th.

The 17th segment is armed with a row of short teeth, which also occur on the proximal part of the 18th, on which are two spines directed forwards, the distal one comparatively long. The left antenna resembles that of the ♀, with short teeth, not recurved, on the first, none on the 3rd, and very short teeth on the 4th and 5th segments, four aesthetasks on the basal joint, a pair on the third, and doubled as far as the 13th segment, after which they are single.

The furcal segments are very divergent, and both 2nd feet are notched, thus differing from *Pl. abdominalis*.

The 5th feet resemble in general those of *Pl. abdominalis*, the bird's head process of the left foot however more erect and not so wide and without any hairs on the external margin, the short segment proximal to this with a strong upward curved spine, the next

segment with a short straight spine, the 2nd basal segment with inner margin haired. The right foot is like that of *Pl. abdominalis* but more slender.

The chief points which distinguish this male from *Pl. abdominalis* are the characters of the anterior antenna (no strong or recurved teeth), the notching of both 2nd feet, and the slenderer 5th feet, also the much smaller size of the whole animal.

From *Pl. robusta* the anterior antennæ are strikingly different, in the possession of small straight teeth, and in being only half the size, though agreeing in the notching of both pairs of 2nd feet. From *Pl. gracilis* the notching of these feet, and especially the structure of the 5th pair in the ♀, the right geniculating antenna, the left-sided pigment ocellus, and 2nd feet are quite distinctive. See Pl. XCVI. figs. 24, 25, 26, 31, 32, 33.

[For the purpose of comparison, figures 34, 35 and 36 of *Pleur. robusta*, from the Faroe Channel, are included in Table I.]

44. *Pleuromamma gracilis* (Claus, *Freileb. Cop.* p. 197; Giesb. *Fauna u. Fl. Neap.* Vol. XIX.).

This is a common species in the Maldive collection.

45. *Pleuromamma ziphias*, Giesb. *F. u. Fl. Neap.* Vol. XIX.

This species occurs sparingly in the Maldive collection. In Giesbrecht's short description of the species, no mention is made of the peculiar character of the 1st pair. The distal margin of the outer half of the 2nd basal carries two spines, the external one very small, the inner one in the form of a curved upright tooth, broad at the base, situated at the articulation of the 1st joint of the exopodite with the basal.

In size the ♀ is from 4·45—4·50 mm. Males were not found. See Pl. XCVI. figs. 27, 37, 38, 39.

Gen. *Lucicutia* Giesb.

46. *Lucicutia flavicornis* (Giesb.).

Average size of the ♀ 1·43 mm.; of the ♂ 1·30 mm. The species occurs with frequency in the Maldive seas.

Gen. *Heterorhabdus* Giesb.

47. *Heterorhabdus papilliger* (Giesb. and Claus).

Occurs sparingly in this collection.

Gen. *Candacia* Dana.

48. *Candace catula* (Giesb.). *Atti Acc. Lincei Rend.* Ser. 4, and *Fauna u. Fl. Neap.* Vol. XIX.

A number of specimens were found, in size reaching to 2·0 mm. and slightly over, but in these the last thoracic segment was produced into rather more acute points, the ventral flap-swelling of the genital segment was more in the middle of the segment, and the 5th feet varied, inasmuch as there were only two bristles on the inner margin, not distally placed as in the type species, but about halfway up the last segment.

This animal, larger and more robust than the type species *C. catula*, occurred frequently, and may be distinguished as a variety of the type species *C. catula*, var. *similis*.

49. *C. curta* (Dana). *P. Amer. Ac.* Vol. II., and Giesbrecht, *Fauna u. Fl. Neap.* Vol. XIX.

50. *C. truncata* (Dana, and Giesbrecht, *Fauna u. Fl. Neap.* Vol. XIX.).

51. *Candace tuberculata*, nov. sp.

♂ 1·9 mm. long. Cephalothorax twice as long as the abdomen, the latter a little unsymmetrical, and with a prominent swelling of the right side of the first segment, extending to the ventral surface, of a warty appearance, three-lobed, and with fine teeth, and a much smaller outgrowth of the right side of the 2nd segment. The right anterior antenna with 6 broad basal joints, the 12th, 13th, 14th and 15th segments swollen, on the 16th joint a row of short rather coarse teeth, a row of strong teeth on the 17th, and fine teeth on the 18th joint proximally. The elbow joint between the 17th and 18th joints. All the teeth pigmented, but none of the segments. The proximal hook of the middle segment of the anterior foot-jaw a little longer and three times as thick as the distal, and deeply pigmented. The 5th feet nearly equal in length, on the left side of three nearly equal segments and a distal lamellar-shaped segment placed at right angles to the others, strong and deeply coloured, and denticulated at the distal end of the 3rd segment. The right foot with the usual spoon-shaped claw and process. The third foot is constructed similarly to the fourth.

This *Candace* has most affinity with *C. catula*, from which it differs in the structure of the 5th feet, the anterior antennæ, and the curious tubercular outgrowths of the abdominal segments. It is also larger. Examples were very numerous in this collection. In a paper by A. Scott ("Some Red Sea and Indian Ocean Copepoda," *vide ante*) is described a species, *Candacia bradyi*, which may possibly be the same animal. Scott's description is of the briefest character—"in general appearance it resembles the male of *C. varicans* Gbt., but the terminal spines of the last thoracic segment are much smaller and the abdomen is slightly asymmetrical.... The chief difference is in the structure of the 5th pair of feet...which is practically the same as the fig. given by Prof. Brady (Pl. XXX.), Challenger Copepoda, but is quite different from the 5th feet of the ♂ of *C. pectinata*." Four figures are given in the accompanying plate. The characters of the abdomen which I have mentioned above are not referred to in Scott's paper, though they are so very characteristic that they could scarcely have been overlooked; and though his drawings of the 5th feet have great similarity with the same in this species there are small differences, especially in the length of the last segment of the left foot. I do not therefore feel assured that these species are identical, and I retain the name I had attached to the species before Mr Scott's paper came into my hands. See Pl. XCVI. figs. 40, 41, 42, 43, 44.

52. *Candace pachydactyla* (Dana), and Giesb. *Fauna u. Fl. Neap.* Vol. XIX.

This Copepod is very abundant in the Maldive collection.

Gen. *Centropages* Kröyer.

53. *Centropages gracilis* (Dana, *P. Amer. Ac.* Vol. II.; Giesb. *Fauna u. Fl. Neap.* Vol. XIX.).

This is very liable to confusion with *C. violaceus*. In general characters both are very similar, the most striking difference being in the structure of the ♀ abdomen, which in

C. gracilis has the genital segment very protuberant ventrally, armed with a knob bearing teeth, and in all Maldive examples with side knobs on the next segment, each bearing ventrally directed teeth, and a large central outgrowth also armed with teeth; between this and the lower end of the genital segment there is also a transparent rounded bladder-like outgrowth.

The anterior antennæ are longer than the whole body by about 5 joints; and without any teeth; of 24 segments, the 1st and 2nd clearly distinct.

The swimming feet have their rami each three-jointed, the 5th pair with the first joint of the exopodite with squarely-shaped inner margin in the distal two-thirds, with rather prominent knob at the proximal end; the long inner spine process of the 2nd exopodite not reaching to the end of the last exopodite joint, and with short bristles distally.

Size of ♀ 1·7 mm.—1·8 mm. See Pl. XCVIII. fig. 7.

The ♂ is 1·7 mm. long, with geniculating antenna on the right side, 2—3 joints longer than the body, of 23 joints, the geniculation between the 18th and 19th, the 17th, 18th and 19th with strongly denticulated upper margin.

AA.	13	14	15	16	17	18	19	20	21	22	23
	13	18	19	20	20	13	15	22	13	13	14

The 5th feet agree with the same feet as figured by Giesbrecht, and differ from those of *C. violaceus*.

It is somewhat curious that though *C. gracilis* occurs with frequency in the Maldives, *C. violaceus* appears to be absent, though mentioned by Scott as occurring "throughout the Indian Ocean." Described by Giesbrecht from the W. Mediterranean, while *C. gracilis* is a Pacific Ocean species, it is probable that the Indian Ocean species of Thompson and Scott is really *C. gracilis*, of which no description is given[1] by which it may be identified.

54. *C. calaninus* (Dana, *P. Amer. Ac.* Vol. II.; Giesb. *Fauna u. Fl. Neap.* Vol. XIX.).

The ♀ is distinguished from the allied species by the shortness of the anterior antennae (only as long, or a little longer, than the furca), the comparatively long anal segment (twice as long as the middle abdominal segment), and the asymmetry of the furcal segments. These are over four times as long as broad, the left one a little shorter and with more convex bend externally than the right segment. The right side of the anal segment has on the ventral surface a flap-like outgrowth in the lower part, appearing in side-view as a ventrally projecting outgrowth. The swimming feet have three segmented exopodites and endopodites, the 5th pair resmbling those of *violaceus* and *gracilis*, except that the spine on the inner side of the exop. 2 is more upright and longer, reaching quite to the end or a little beyond the distal margin of the exop. 3. The 1st joint of the exopodite has the same square inner margin with proximal knob, as in *C. gracilis*. Size 1·9 mm.

See Pl. XCVIII. figs. 6, 15.

55. *C. elongatus* (Giesb. *Zool. Jahrb. Syst.* Vol. IX. p. 322) is remarkably like *C. calaninus*, but differs essentially in the anatomy of the abdomen of the ♀, the furcal segments being quite symmetrical, the genital and succeeding segments without lateral knobs, the anal and

[1] *Report on Pearl Oyster Fisheries of Ceylon*, Copepoda.

middle abdominal segments about the same length. The anterior antennae are only one or two segments longer than the whole body.

The 5th feet resemble those of *C. calaninus*, the spine of exop. 2 being however not much longer than the end joint of the exopodite, and shorter than in *C. calaninus*. Size of the ♀ 1·54 mm.

The species is fairly common in this collection.

The ♂ is 1·8 mm. long, with geniculating antenna on the right side not quite reaching the end of the furca, of 23 joints, with elbow joint between the 18th and 19th.

AA.	12	13	14	15	16	17	18	19	20	21	22	23
	7	9½	13	14	15	13	14	13½	13½	8½	9½	10½

The 5th feet are quite characteristic (see figure). The conjoined 2nd and 3rd exopodites of the left foot appear to terminate in a hollow tube-like opening, guarded on each side by the fringed margins of the anterior and posterior chitinous surfaces. The female segments are quite symmetrical.

See Pl. XCVIII. figs. 6, 15.

56. *C. orsinii* (Giesb. *Atti Acc. Lincei Rend.* Ser. 4, Vol. v.; *Fauna u. Fl. Neap.* Vol. XIX.).

The last thoracic segment on each side carries on its rounded margin a small lateral point. The anterior antennæ are only about 4 or 5 joints longer than the cephalothorax. The 1st and 2nd joints of the endopodites of the first, second and 3rd feet are coalesced, those of the 4th pair partially fused. The abdomen is characteristic, the genital segment with a downward and forward projecting spine on the ventral surface, the anal segment much shorter than the middle abdominal segment, and the furcal segments only as long as the anal.

The 5th feet are different on each side; that of the right side with short, stout spines on the distal margin of the 2nd exopodite, directed nearly at right angles to the foot, and denticulated on the upper distal margin; that of the left side with a curved stout spine arising from the distal inner margin of the exop. 2, distally ending in three divergent spines.

Size of the ♀ 1·7 mm. Pl. XCVIII. figs. 5, 13.

The ♂ has the right antenna geniculating, of 23 joints, the 14th to the 16th joints very broad, the elbow joint between the 19th and 20th. The 18th, 19th and 20th joints with strongly denticulated upper margins, the 16th and 17th segments each with strong forward projecting spines.

The 5th feet of the left side with 2-jointed exopodite, strong marginal spine on exop. 2, and distal curved spine on exop. 3; the endopodite as long as the exopodite. The right foot with 3-jointed exopodite, long curved hook on the proximal inner margin of the exop. 2, the exop. 3 rather pyriform basally and produced into a curved spine like a Heterorhabdus foot. The 2nd basal of the right fourth foot has two singular curved processes, the thick proximal portion being much hardened and of almost calcareous feeling, with a short erect spine just distal to the process.

Size of the ♂ 1·54 mm. Pl. XCVIII. figs. 1, 4, 8, 11, 12.

C. orsinii occurs with frequency in this collection.

57. *C. furcatus* (Dana). Giesb. *Fauna u. Fl. Neap.* Vol. XIX.

The ♀, 1·6 mm., is distinguished by the prominent and deeply orange pigmented 'eye' on the ventral aspect of the head, the possession of strong hooks on the 1st, 2nd and 5th segments of the anterior antennæ, the length of these organs not reaching more than two to three segments longer than the whole body: the possession of external strong spine projection of the last thoracic segment extending beyond the end of the genital segment, and a second smaller spine internal to this. The abdomen has the genital segment and anal segment of about equal length, each more than twice as long as the short middle segment, the furcal segments equal in length, longer than the anal. The 5th feet are in general form like *calaninus, gracilis,* &c., but the spines of exop. 2 are much shorter than the exop. 3.

The ♂, 1·55 mm. long, has the right antenna of geniculating form, the elbow between the 18th and 19th segments, spines on the enlarged 15th and 16th joints very small or absent, the denticulations on the margins of 17th, 18th and 19th fine; the 19th segment (the one after the elbow joint) larger than the next two, and not quite twice as long as the 18th. The 5th pair of feet, on the right side with strong claw arising from the base of the exop. 2; exop. 3 a curved spiny process with short marginal spine; the exopodite of the left foot of only 2 segments, the distal much larger than the proximal, ending squarely and with strong apical external marginal spine, curved bristle on the inner margin and between them a broad-based conical spine, covered with short stiff bristles.

C. furcatus occurs with frequency in this collection.

Gen. *Labidocera* Lubbock.

58. *Labidocera acuta* (Dana). Giesb. *Fauna u. Fl. Neap.* Vol. XIX.

59. *Labidocera kröyeri* var. *similis* (*L. kröyeri*, Brady, *Challenger Report*, Copepoda).

♀, length 2·0—2·3 mm. Last thoracic segment with short spines on each side and with partial segmentation by a line on the anterior margin of the segment, but no trace on the back. Anterior antenna of 23 joints, a little longer than the cephalothorax. Head with side hooks and pair of dorsal lenses separated from each other by much more than the width of a lens, and a rather large ventral 'eye.'

Abdomen of 3 segments, very unsymmetrical.

G. S. : Ab. 2 : Anal :: 17 : 11 : 9 (dorsal aspect). Anal segment much shorter on the right side than the left. Furcal segments very unsymmetrical, the right much broader and longer than the left, each with 5 apical setæ and a dorsal short appendicular bristle. The bristle next to the innermost is the longest, and little more than half the length of the abdomen. The abdomen is beset with spines and bristles. The genital segment has on the dorsal aspect two very stout rather long spines (one on each side), the middle segment has warty outgrowths from the posterior margin, and the anal has two outgrowths, spiny or warty, from the right distal margin, and spiny outgrowths from the other side. The ventral side of the genital segment is armed at the distal margin with 6 short spines, two below the genital orifice, and in pairs, laterally there are no other spines. The whole surface, back and front, of the abdominal segments, is covered with short hairs and prickles, especially prominent being bundles of short stiff hairs on the middle segment.

The 5th feet consist of a pair of basal segments, and on each side an endopodite and exopodite, the former very short, not half the length of the exopodite, rather pyriform in shape and bifid at the apex. The exopodites of the two sides are rather different in length, that of the left side longer and thinner than the right, three very short marginal and an apical spine, and on the inner margin, two prominent spines distal of the centre. See Pl. XCVIII. figs. 22, 23, 33.

At first sight this Copepod appears to suggest identity with *L. kröyeri* (Giesb.). But very distinct differences are to be found in the anatomy of the furcal segments, the length of the anal segment (as long as the middle) and of the fifth feet. It does not either resemble Brady's *Pontella kröyeri* (which Giesbrecht has regarded as identical with *L. kröyeri*).

60. *L. Wollastoni* (Lubbock). *Ann. Nat. Hist.* Ser. 2, Vol. xx.

This animal is distinguished by the possession of extremely large dorsal 'eyes,' side hooks on the head, the abdomen of 3 segments, of which the genital segment exhibits a remarkable dorsal swelling, the furca similarly but less swollen. The last thoracic segment is prolonged on each side into rather long and at the tips slightly divergent spines. The 5th feet have very broad and long basals, and comparatively short exopodites and endopodites, the latter about three-fourths as long as the former, very conical, thick basally and ending in a distal point, without spines, the exopodite of similar shape but much larger, with two very small terminal teeth, but no marginal spines.

The ♂, 2·0 mm. long, has a characteristic pair of 5th feet. The 'bird's head' process of the right foot has a prominent tubercular outgrowth in the middle of the margin, a smaller one proximally with a seta, and a long broad based spine at the proximal end. The left foot, of two branches, has the outer unsegmented and ending in a strong curved tooth, the external margin strongly haired; the small inner branch of two segments distinctly with two marginal and one terminal spines.

The right anterior antenna, with short broad based process on the 17th segment, strongly denticulated margin on the next segment, the distally following joint with less prominent marginal teeth, the proximal of the three end joints with rather long spines distally, nearly as long as the next segment. Pl. XCVIII. figs. 17, 30, 31—35.

61. *Labidocera detruncata*, var. (*L. detrunc.*, Dana, *P. Am. Ac.* Vol. II.; Giesb. *Fauna u. Fl. Neap.* Vol. XIX.).

♀ 2·4 mm. long, without cephalic side hooks; dorsal eyes rather small, ventral eye very large and plum-coloured; large splashes of plum-coloured pigment in the lower part of the thorax. Abdomen of 3 segments, genital very large, anal very small, the former with prominent swelling dorsally in the lower part, and with ventral swelling, though much less. The genital orifice ventrally projecting and placed at the lower part of the segment, the dorsal swelling with several transparent tubercles projecting.

The last thoracic segment pointed on each side and projecting dorsally. Furcal segments of similar size, reniform, the right one on a higher plane than the left, with on each side one bristle with bulbous swelling at the base, the others less thickened. The anal segment with a conical swelling projecting downwards between the furcal segments. The 5th feet with strongly bent exopodite with rather long terminal spine, a shorter spine on the inner margin distally, the outer margin with 3 stout spines. The endopodite is short (about

one-third the length of the exopodite, very thick basally, conical and tapering to a point. See Pl. XCVIII. figs. 16, 19, 21, 34, 36.

This Copepod closely resembles either *L. detruncata* or *L. pavo*, and is difficult to identify with either of these.

Brady (in *Challenger Report*) has under the name of *Pontella detruncata* figured two pairs of 5th feet of females, the one of which on Pl. XLV. corresponds entirely with the specimen described above. Brady's figure of the abdomen is however quite different; probably his description is made up from more than one species.

A ♂, which is referred to below, appears to agree with Brady's *Pontella detruncata* ♂, but is larger than the female above described and the two are therefore probably not the same species. One female and three males only were found in this collection.

The female does certainly not entirely agree with Giesbrecht's description of *L. detruncata*[1], especially in the spinulation of the 5th feet, though it is more decidedly not identical with *L. pavo* Giesb.

The ♂ is 2·6 mm. long, with dorsal and ventral eyes, the right side of the last thoracic segment a little more produced than the left, abdomen of 5 segments, the tail segments not unsymmetrical or broadened. Right anterior antenna 17-jointed, the 9th, 10th, and 11th swollen, the 12th, 13th, and 14th segments bearing toothed or tuberculated upper margins, the elbow between the 13th and 14th segments. The left antenna 23-jointed. The geniculating antenna closely resembles Brady's figure of *P. detruncata*. The 5th feet are not so disproportionate in size as figured by Giesbrecht in *L. detruncata*, the 'bird's head' process is without processes or spines on its margin, the last joint of the left foot is haired all along one margin, and with four rather long but not bent processes on the opposite margin.

The animal is distinguished by a great deal of blue pigment especially colouring the antennæ and feet, the dorsal eyes are very large and close together, the ventral eye deeply pigmented and red-currant jelly colour.

62. *Labidocera minuta* Giesb. (*F. u. Fl. Neap.* Vol. XIX.).

♀ 2·0 mm. long. Head with small side hooks. The last thoracic segment produced distally on the right side and carrying a short spine directed forwards almost horizontally. The left side not produced and rounded without any spine. The dorsal eyes are comparatively small and close together. Anterior antennæ of 23 joints reaching beyond the end of the genital segment. The abdomen of three segments, of which the genital is much longer than the middle one, and the anal is very short. Furcal segments a little unsymmetrical, the right one a little broader than the left, and both about the same length.

The genital segment has a lateral swelling on the right side occupying the whole segment, and an outgrowth of the left side originating in its upper fourth. In the centre (of the ventral aspect) in its upper portion is a chitinous outgrowth of small size. The genital opening is situated at the extreme distal end of the segment. The middle segment has an

[1] *L. detruncata*, abd. 3-jointed, 'analdeckel' long, furca broad. Exop. of 5th foot with two points at the end. End. half as long as exop., thick conical. Size ♀ 2·25—2·58 mm. *L. pavo*, abd. 2-jointed, genital segment with median and right-sided outgrowths, furca broad kidney-shaped. Exop. of 5th foot with three points at the end, and two rather large points on the outer margin. ♀ 2·12 mm. (the endopodite of one side is only a small process of the 2nd basal, not articulating). Giesbrecht u. Schmeil, *Tierreich*; Giesbrecht, *F. u. Fl. Neap.* Vol. XIX. p. 457.

outgrowth occupying the right side and ventrally projecting, and the ventral surface of this segment is covered with small prickles and chitinous tubercles. The anal segments are a little asymmetrical and produced on the dorsal aspect over the corresponding right furcal segment. The tail seta next to the innermost is very long.

The 5th feet of the female have a broad based tapering exopodite ending in two rather deeply cleft upright points; the endopodite is in the natural condition in all cases bent outwards over the exopodite, is short, broad based, and ends in an apical spine and a rather shorter spine on the inner margin. Several specimens were found in this collection, and in all except one the whole abdomen was invested with a tough colourless membrane of irregular shape, resembling that described by Scott in his *L. darwinii* (*Tr. Linn. Soc.* Vol. VI. Part I. p. 84). Pl. XCVIII. figs. 18, 24, 25.

The ♂ is 1·54—1·6 mm. long. The last thoracic segment is produced on the right side into a long narrow process; the left side ends in a very much shorter process. Except for slight swelling of the left side of the 1st abdominal segment the abdomen is perfectly symmetrical.

The 5th pair of feet have the usual 'bird's head' process on the right foot, with a transparent rounded outgrowth of the inner margin with seta proximal to it, the first basal joint with a few marginal spines; the left foot of three segments has the last one haired marginally, and with a distal short spine and two terminal short broad processes.

The anterior antenna of the right side has the 17th joint with rather long, horizontally lying, and attenuated spine on the upper margin, the following joint with two rows of fine teeth on the upper margin, the succeeding joint the longest, with a row of fine marginal teeth, the most proximal of the distal three segments with short rather thick spine on the upper margin distally, slightly denticulated. Pl. XCVIII. figs. 29, 32, 37.

63. *Labidocera laevidentata.* Brady (*Challenger Report*, Vol. VIII.).

Only males of this species are known, and several examples occurred in this collection.

Size 1·9 mm. Head with side hooks; the right side of the last thoracic segment ending in two spines, the left with only one.

The anterior antenna of the right side, on the joint before the segment bearing the denticulated margin, bears distally a triangular process on the external margin, rather like the plume of a feather, with a midrib; the next joint has the proximal portion of the teeth-bearing margin raised and rounded, the following joint has a denticulated margin throughout only its proximal half, and distally this is produced into a stout upward curved spine.

The 5th feet, of the usual Labidocera structure, have the proximal extension of the 'bird's head' process simple, with only a few distal marginal hairs, the margin of this process without spines or tubercles, the long spoon-shaped distal process quite simple. The left foot with short broad terminal joint with four rather long simple processes, one of which, the longest, is bent backwards at the base, the other three being straight. On the proximal surface of this segment is a number of rather stiff bristles radiating outward.

Brady (*Challenger Report*, p. 93) described the species from only one specimen captured off the Philippines and Giesbrecht[1] mentions it but does not describe it. Although there

[1] *F. u. Fl. Neap.* Vol. XIX.

are some small points of difference according to Brady's drawings, I have little doubt that this Maldive species is identical, but a little larger. See Pl. XCVIII. figs. 20, 26, 27, 28, 38.

Gen. *Anomalocera* Templ.

64. *Anomalocera pattersoni* (Templeton).

The occurrence of an undoubted example of *A. pattersoni* in this collection is curious. The specimen was a ♀ of 3·6 mm. length. There is no essential difference between it and females from more northern latitudes.

Gen. *Pontella* Dana.

65. *Pontella spinipes* (Geisb.). *F. u. Fl. Neap.* Vol. XIX.

♀. Dorsal, ventral and rostral lenses, the latter rather small. Last segment of the cephalothorax asymmetrical, the lateral point on the right side very much shorter than the left; inside these two spiny prolongations a rounded plate on each side. Abdomen two segments only, the right distal portion of the genital segment prolonged on the dorsal surface over the right furca and also into an outgrowth dorsally on the same side. The anal segment very short, the right furcal not really longer than the left but lower distally.

Fifth feet with exopodite ending in a point and curved inwards distally with 2 short spines about the middle of the external margin, the endopodite about half the size and bifid at the apex.

The animal is very highly coloured with streaks of red and much blue pigment, especially about the foot-jaws, bases of the antennae, feet and tail. Size 4·5 mm.

The ♂, 4·0 mm. long, hitherto unknown, closely resembles that of *P. securifer*, but differs in the structure of the 5th feet and in slight differences in the clasping antenna. The former is best understood from the drawing, and consists chiefly in the absence of the big spiny process on the proximal part of the claw of the right foot which occurs in *P. securifer*, and in the presence of a very rounded outgrowth of the margin of the claw near its middle and leaving some distance between it and the proximal spine process. In the left foot, the last joint has one long external marginal spine and three terminal spines, of which the outer is the largest, the surface and inner margin of the joint haired.

The segment of the anterior antenna after the elbow joint in *P. spinipes* has an elevated rounded projection with three arrow-shaped teeth, which in *P. securifer* are represented by a number of lamellar-like processes. The marginal teeth on this segment are rather larger than in *P. securifer*, and the toothed plate[1] articulating with the joint before the elbow is comparatively a little larger in *P. securifer* than in *P. spinipes*.

The relative lengths of the joint before the elbow, the joint after, and the long end joint are proportionately:

	1	2	3
P. spinipes	47	45	60
P. securifer	40	50	60

Thus in the former species the joint before the elbow is a little longer than the succeeding joint, while in *P. securifer* the segment after the elbow joint is the larger.

[1] The 'Reibleiste' of Giesbrecht.

The last thoracic segment in *P. spinipes* ♂ is much more produced anteriorly than in *P. securifer*. The rostral lenses in this species are large, but in *Pontella* species it often happens that this organ is larger in the ♂ than in the ♀. The abdomen and furcal segments are quite symmetrical.

There is no doubt a very considerable resemblance in this animal to the ♂ of *P. securifer*. Three females occurred in one plankton sample along with one male, and it may be inferred that *P. spinipes* is not uncommon in this locality. Only one example of *P. securifer* ♂ occurred in the collection. *P. spinipes* ♂ as well as the ♀ is coloured much like *Anomalocera*, on the thorax with blue and red pigment, the ventral eye especially of a deep cherry-red, violet and red coloration predominating on the thorax, feet, antennæ and foot-jaws.

66. *Pontella securifer* (Brady).

Rare in this collection.

67. *Pontella mediterranea* (Claus, *Freilebende Cop.*; Giesb. *F. u. Fl. Neap.* Vol. XIX.), var. *indica*.

♀ 3·1 mm. long, ventral eye cherry-red, rostral lenses flat and insignificant; furcal segment of the right side a little the longest, that of the opposite side bent and distorted. Last segment of the thorax with rounded and symmetrical margins. Abdomen of only two segments, the genital segment long, not strongly projecting ventrally, and nearly four times as long as the anal.

Fifth feet with exopodite comparatively broad, and not curved, three terminal spines, the middle one the largest, two spines wide apart on the external margin, and two strong spines close together in the distal half of the inner margin. The endopodite very short, pear-shaped, ending in a broad point uncleft.

These feet differ a little from the same feet of *P. mediterranea* as described and figured by Giesbrecht (*F. u. Fl. Neap.* Vol. XIX. Pl. XXIV. fig. 48), in the size of the external spines of the exopodite and the uncleft endopodite, but the differences are only varietal.

68. *Pontella fera* (Dana, *P. Amer. Acad.* Vol. II.; Giesb. *F. u. Fl. Neap.* Vol. XIX.).

One ♀ occurred in this collection and there is no doubt that it is identical with *P. fera* as described by Giesbrecht.

Gen. *Pontellopsis* Brady.

69. *Pontellopsis krämeri* (Giesb. *Zool. Jahrb. Syst.* Vol. IX.), var.

♀, size 2·0 mm., the cephalothorax broad posteriorly, narrow anteriorly, the last segment ending in two stout lateral spines, that of the left side straight, that of the right side standing out more horizontally. Abdomen of 2 segments, the genital large and with a dorsal process, the anal short, the furcal segments (and anal in less degree) asymmetrical, the right one much broader and a little longer than the left. A strong bifid rostrum and ventral eye, partially covered ventrally by a large epistome strongly haired: no dorsal or rostral lenses. Anterior antennæ 16-jointed, with strong forward projecting hook on the 5th segment. Posterior antennæ with long endopodite and extremely short exopodite, only about the length of the 1st basal joint.

Mandibles with numerous but stumpy closely set teeth. Anterior foot-jaws with long distal bristles. Posterior foot-jaws with all lobes on a forward process of the 1st basal, the

second basal and four-jointed endopodite forming a secondary branch. The maxillæ with strong 2nd inner lobe with three teeth like those of the 1st inner lobe, 2nd basal and outer lobes small.

Feet like *Pontella*. 5th pair comparatively short, exopodite curved, with two slender external spines, two terminal spines, and a strong and longer spine arising as a process of the segment at the distal inner margin. Endopodite three-fourths as long as the exopodite, with stout terminal spine and similar spines arising just below it from the inner margin.

Pl. XCVIII. figs. 39, 40, 41.

This animal bears much resemblance to *P. krämeri* Giesb., as described and figured by Giesbrecht in *Zoolog. Jahrbuch*, 1896, but the furcal segments are not nearly so asymmetrical, and the 5th feet differ a little in the form of the end spines of the exopodite and length of the endopodite.

Only one example was found in this collection.

70. *Pontellopsis armata* (Giesb. *F. u. Fl. Neap.* Vol. XIX.).

♀ size, 2·4 mm.; last thoracic segment produced into long spines reaching to the end of the genital segment. Abdomen of 2 segments, anal nearly as long as the genital, both segments very unsymmetrical, the genital with strong dorsal lateral swellings, the anal with strong projection distally, covering the furcal segments partially on the dorsal surface and projecting between them, also raised dorsally at the proximal extremity; furcal segments not really unequal in length, but apparently so from the anal segment asymmetry. Genital orifice with strong spine at lower margin directed towards the right side.

Feet like *Pontella*. 5th pair with endopodite half the length of the exopodite. The former distally cleft and ending in two rather long spines, the latter curved, with three distal marginal spines, the median one much the longest and stoutest, the outer and inner of about the same length, two short spines on the external distal margin, and a short one about midway on this margin.

The whole abdomen is especially hirsute, with short stiff bristles; the thorax similarly hirsute, but with shorter bristles, and prickles. The ventral eye rather large and deeply cherry coloured.

The animal bears a close resemblance to Giesbrecht's description and figures, but the marginal spines of the thorax are not quite so long. Only one specimen was met with.

See Pl. XCIX. figs. 1, 2, 3.

Gen. *Pontellina* Dana.

71. *Pontellina plumata* (Dana) is common in this collection, and except that in some examples there is considerable asymmetry in the anal segment of the female (the anterior aspect being produced over the right furcal segment), the latter being placed at a lower level than the left one (apparently though not really larger), there is no essential difference between this species and the same species from the Mediterranean.

Gen. *Parapontella* Brady.

72. *Parapontella brevicornis* (Lubbock).

One male specimen occurred, which in no way differed from examples of the same

species from the Atlantic or Mediterranean. Size 1·2 mm. Its occurrence in this region is somewhat remarkable.

Gen. *Temora* Baird.

73. *Temora discaudata* (Giesb.).

74. *Temora stylifera* (Dana).

Both common.

Gen. *Calanopia* Dana.

75. *Calanopia elliptica* (Dana).

76. *Calanopia minor* (A. Scott, *Liverpool Biol. Soc.* Vol. XVI. 1902).

Gen. *Acartia* Dana.

77. *Acartia negligens* (Dana).

78. *Acartia Danae* (Giesb.).

79. *Acartia tonsa* (Dana).

80. *Acartia erythreae* (Giesb.).

Gen. *Oithona* Baird.

81. *Oithona plumifera* (Baird).

82. *Oithona similis* (Claus).

83. *Oithona rigida* (Giesb. *Zool. Jahrb.* 9 Band, 1896).

Several examples of this little-known species occurred in this collection. The pointed frontal process is absent and the head is square, between the antennae, the latter are very short, not reaching beyond the second thoracic segment, the genital segment is not more than twice the length of the next, the furcal segments are $2\frac{1}{2}$ as long as broad, and the external bristle only as long as the furca. The marginal spines of exop. 3 of the three first pairs of feet are very similar.

The whole animal is very rigid in appearance. Size 0·80 mm. As Giesbrecht remarks it is nearly related to *O. nana*. Pl. XCIX. fig. 42.

84. *Oithona nana* (Giesb.).

85. *Oithona tropica*, nov. sp.

♀, length 1·75 mm. Cephalothorax and abdomen about equal in length. Head produced in front into strong pointed process, slightly bent downwards at the tip; visible from the dorsal aspect, long and sharply pointed.

Anterior antennæ reach about the end of the genital segment and are of 13 segments:

1	2	3	4	5	6	7	8	9	10	11	12	13[1]
10	14	12	4	18	25	22	7	11	25	5	5	6

Mandibles and maxillæ of the usual *Oithona* type, the former with four bristles on the endopodite, the proximal one very stout, the other three much shorter and more slender, and two stout hook-like bristles on the end of the 2nd basal. Maxilla with 2nd basal rather

[1] The small 4th joint, clearly segmented in one antenna, is not present in the other, the 4th (4+5) being one long joint and making the number of segments in the antenna 12.

extended, endopodite with one short bristle; second basal with a short bristle, 3rd inner lobe with two stout hooks and one fine bristle. Anterior and posterior foot-jaws of the usual type and not very unequal in size.

1st pair of feet with	1, 1, 3	marginal spines on the exopodite							
2nd	„	„	1, 0, 2	„	„	„	„	„	„
3rd	„	„	1, 0, 1	„	„	„	„	„	„
4th	„	„	0, 0, 1	„	„	„	„	„	„

The inner marginal bristles of the 2nd basal not swollen like *O. setigera.*

The relative lengths of the 4 abdominal segments, 34 : 19 : 17 : 21. The furcal segments 17 long and 6 broad.

In the feet the marginal spines of the 1st pair are unequal in size, that of exop. 1 very long and stout, the proximal of exop. 3 the shortest, the middle one a little longer, the distal the longest. A short marginal bristle exists on the inner side of the exop. 1, a short straight spine-like seta on the 2nd basal inner margin, the seta of the outer margin of the 1st basal is not as long as the exopodite, the inner marginal bristle is comparatively long and thin (not club-shaped as in *O. setigera*). The outer marginal spines of the 3rd and 4th feet delicate, those of the exop. 3 long and thin. In the 4th foot the endopodite is short, only reaching as far as the first inner marginal bristle of the exop. 3 (differing from *O. frigida* or *plumifera*). The 1st exopodite in all pairs with a short bristle on the inner margin.

There has always been doubt as to the identity of Brady's *O. challengeri* (*Chall. Rep.* p. 97). In size greater than any known species, viz. 1·8 mm., abdomen nearly as long as the cephalothorax, the various joints nearly equal in length: anterior antenna of 13 joints (second, third and last four very short, 4th, 5th, 9th the longest). First feet with 3 marginal spines on last joint of the exopodite, branches of the 2nd, 3rd, 4th with no marginal spines; fifth foot consisting of a small tubercle with two long biarticulate setae: caudal segments nearly as long as anal, with 6 setae, the outermost and innermost the shortest. Such is Brady's description, and the species has not been completely identified since. As Giesbrecht remarks (*F. u. Fl.* p. 540), all Brady's Challenger *Oithonas* are grouped together under one specific name and probably comprise several kinds, and he further remarks that Brady's figures 1 and 2 show most resemblance to *O. setigera.*

The large species captured in the Maldive Archipelago shows some resemblance to Brady's *O. challengeri*, but cannot be identified with that, the spinulation of the feet, the structure of the 5th feet, the relative proportions of the abdominal segments alone being different. It cannot also be identified with *O. setigera* Dana, Giesb. (*loc. cit.*), the absence of the club-shaped bristles of the 2nd basals of the 2nd pair, and different proportions of thorax and abdomen, and the relative length of the segments of the latter, distinguishing it, though the marginal spines of the 1st and 2nd feet are the same in number. It must therefore be regarded as a new species.

See Pl. XCIX. figs. 44, 45, 46, 47, 48.

86. *Oithona robusta* (Giesbrecht, *F. u. Fl. Neap.* Vol. XIX. p. 538 *et seq.*).

♀ 1·5 mm., ♂ 1·2 mm. Forebody a little longer than the hindbody (16 : 14), twice as broad as long, produced in front into a strong pointed rostrum, visible from the dorsal surface and not ventrally directed.

The anterior antennæ are short and reach only just beyond the end of the thorax, in the ♂ a little shorter. The mouth parts resemble the figures given by Giesbrecht, the endopodite of the mandible with 4 bristles, the proximal much the largest, the distal three of unequal length: the endopodite of the maxilla with 2 bristles. The anterior and posterior foot-jaws are more equal in size than in other species. The marginal spines of the 1st to 3rd pairs of feet on the exopodites are 1 : 1 : 3, and in the 4th pair 1 : 1 : 2 only. The terminal saws of the feet are especially strongly toothed, there is no inner marginal bristle on the 2nd basal of the 1st pair, but a very short inner marginal on the exop. 1 of all the feet. The outer marginal spines of the 3rd and 4th pairs are particularly long.

The relative proportions of the abdominal segments are as 25 : 12 : 12 : 13, and the furca is 12 long and 3½ broad, its outer marginal bristle short and thin.

The head is apparently more pointed than in the figure of the species given by Giesbrecht, but in all other details the animal appears to agree very well with this writer's description, and there can be little doubt that it is identical.

The ♂ has the antennæ rather shorter than the ♀, the relative proportions of the abdominal segments 10 : 10 : 12 : 9 : 9 : 6; the furca 7 long and 4 broad. The joints of the anterior antennæ are much coalesced, the right one in the only male example found being unfortunately broken in the distal part, the left one is not a geniculated antenna. The mouth organs and feet resemble those of the female. Several females were found in this collection. Pl. XCIX. fig. 43.

87. *Oithona linearis* (Giesbrecht, *F. u. Fl. Neap.* Vol. XIX. p. 538 *et seq.*).

1·2 mm. long. The head rounded with no rostrum visible dorsally, the cephalothorax 3 times the breadth of the abdomen, and shorter than the latter (11 : 13). The segments of the posterior body proportionately 9 : 23 : 12 : 11 : 9, and the furca 6½ long and 3 broad.

The anterior antennæ have the joints apparently much coalesced and very difficult to determine, only 7 or 8 distinct segments being visible. The endopodite of the mandible has four bristles.

Feet:	1st	pair	with	1, 1, 3	marginal spines
	2nd	„	„	1, 1, 2	„ „
	3rd	„	„	1, 0, 1	„ „
	4th	„	„	0, 0, 1	„ „

The long narrow body, the hinder portion of which is longer than the anterior, and the spinulation of the feet, are characteristic points distinguishing this species. Several examples occurred in this collection. See Pl. XCIX. fig. 49.

Gen. *Thaumaleus* Kröyer.

88. *Thaumaleus tropicus*, nov.

One example occurred of a female, 2 mm. long, the proportions between the length of the antenna, the length of the body from extremity of head to mouth, and from mouth to the end of the first thoracic segment respectively as 5 : 5 : 23.

In the anterior antenna the 2nd segment was very much longer than the 3rd. The third exopodite joint of the first pair of feet carried three inner marginal hairs; the 5th pair had each a rudimentary endopodite, the inner bristle of the three at the distal end of the endopodite much thinner and shorter than the other two.

The long abdominal process ('eigabel') was twice as long only as the abdomen, and not much more than a third of the length of the whole body, and consisted of two distinctly independent processes, separated at the base and throughout the length.

The furca has on each side three setæ of equal thickness, but being broken the length cannot be determined.

The lateral eye-spots are large and the ventral eye especially strongly pigmented.

The anterior antennæ differ from those of *T. longispinosus*, also the body segments and abdominal process; the body proportions and 5th feet especially from *T. clarapedii*; the absence of reticulated appearance, the body proportions, abdominal process, and 5th feet differ from the same parts in *T. reticulatus*, the body proportions, abdominal process, and especially the size from *T. thompsonii*.

T. clarapedii, reticulatus, longispinosus are warm area species (41° N.—51° N.), *thompsonii* a northern cold area species.

The single Maldive specimen appears to differ so much in several particulars (enumerated above) as to necessitate the creation of a new species. Representations of this curious genus have not apparently been recorded from the tropical area.

Plate XCIX. figs. 31, 32, 33.

Gen. *Tortanus* Giesb.

89. *Tortanus gracilis*, Corynura. Brady, *Chall. Rep.*; Giesb. *F. u. Fl., Tortanus*; Giesb. u. Schmeil, *Das Tierreich*, p. 157.

This species occurred several times in the Maldive collection, males being as frequent as females. It is recorded by Brady (*Chall. Rep.*) from the Philippines and by Cleve from the Malays, but not by Thompson and Scott from Ceylon, where it was apparently replaced by *T. forcipatus* Giesb. The latter species does not occur in this collection. Its identity is doubtful and Cleve has lately published reasons ("Plankton from the Indian Ocean," &c.) for the belief that *T. gracilis* and *forcipatus* are identical, the only essential difference being in the symmetry or asymmetry of the 5th feet. In *T. gracilis* these are never quite symmetrical, the left being constantly a little longer than the right foot. Cleve's measurements of size agree with my own inasmuch as both make the species smaller than Brady (viz. 1·6—1·8 mm. Brady 2·1 mm.).

Gen. *Corycæus* Dana.

90. *Corycæus ovalis* (Claus).

91. *Corycæus longistylis* (Dana in part = Dahl, *Verh. deutsch. Zool. Gesell.* 1894.

92. *Corycæus speciosus* (Brady).

93. *Corycæus venustus* (Dana).

94. *Corycæus obtusus* (Dana).

95. *Corycæus dancæ* (Giesb. = *C. crassiusculus* (Dana), cf. Dahl, *loc. cit.*).

Of the forms of *Corycæus* with spoon-shaped prolongation of the thorax are included in Giesbrecht's work, *C. rostratus, carinatus, longicaudis, concinnus, gibbulus*. Dahl (*loc. cit.*) admitting *rostratus* (Claus), *gibbulus* (Giesb.), *concinnus* (Dana), *carinatus* (Giesb.), further includes *gracilis* Dana (= *pellucidus* Dana) and makes a new species *tenuicauda* (= *C. longicaudis* (Giesb.), *C. longicaudis* Dana = *C. speciosus juv.*).

Brady (*Chall. Rep.*) described *C. pellucidus* Dana (with which *C. megalops* (Willemoes-Suhn) appears in many respects to be undoubtedly identical), but of Brady's description and figures Giesbrecht (*F. u. Fl.* p. 662) remarks that he has confused two kinds and he regards Dana's species *pellucidus, gracilis, deplumatus,* and *productus* as very doubtful. Dahl however revives Dana's species *gracilis* (see above) as identical with *pellucidus* ♀ of Dana, and his synoptical diagnosis of those five kinds may be here referred to.

Bristles on basal joints of Post. Ant. feathered: the ♀ with a spoon-shaped thoracic ventral prolongation and one-jointed abdomen.

A. 4th feet without endopodite: furca very short: animal very small, = *C. rostratus* Claus.

B. 4th feet with endopodite with one bristle: furca longer.

I. External bristle of furca short and thick, = *C. gibbulus* Giesb.

II. Bristles of the furca thin.

1. Genital openings near the distal end of the abdomen, the upper and lower margins of which are parallel, = *C. concinnus* Dana.

2. Genital openings of ♀ set at end of abdomen.

α. The widened part of the ♀ abdomen as high as long in the upper margin.

i. Furca longer and thinner, the widened forepart of the ♀ abdomen with horizontal upper edge axially concave in the upper margin, = *C. gracilis* Dana (♀ = *pellucidus* Dana).

ii. Furca shorter and thicker, the widened part of the abdomen with swollen upper margin, = *C. carinatus* Giesb.

β. The widened part of the ♀ abdomen double as long as high, = *C. tenuicauda m.* (= *C. longicaudis* Giesb. and Dana = *C. speciosus juv.*).

The *Corycæus pellucidus* of the Maldive collection is I think identical with Willemoes-Suhn's *C. megalops*, and probably with Giesbrecht's *C. gibbulus*. As all specimens are females it is difficult to say whether the ♂ of *C. gibbulus* described by Cleve is identical.

96. *Corycæus pellucidus* (Dana. Brady, *Chall. Rep.*).

·85 mm. long (—·90). Head with a pair of prominent and comparatively large reddish-coloured lenses. Thorax with long downward directed ventral process; in some specimens can clearly be traced a connection between the corneal lenses and a gland from which a long yellow process extends into the thoracic process, exactly as in Willemoes-Suhn's figure (*Chall. Rep.*). The second thoracic segment has a strong dorsal hump. A trace of division of this segment anteriorly is present in all specimens, and at the distal end it is prolonged into long winged processes extending half the length of the abdomen. The latter of one segment only is in its upper margin produced at its forward end into a rounded and strongly haired process. Dorsally of irregular and swollen shapes, especially in the lower third, the genital openings are situated at the lower end of the segment with a mass of yellow brown pigmented matter, to which are, in all cases, attached two or three transparent oval spermatophores. Laterally viewed, the abdomen is oblong, and is nearly twice as long as broad in its broadest part, i.e. the lower third. The furcal segments are only half (or less) as long as the abdomen, and three to four times as long as broad. These propor-

tions however vary in different specimens, of which the following measurements of 6 specimens are examples ($\frac{7}{10}$ths = $\frac{6}{100}$ mm.).

Length of furca	Breadth of furca	Length of abdomen	Breadth of abdomen (in tenths)
8	$2\frac{1}{2}$	24	12
11	3	25	14
10	3	22	11
10	3	24	15
9	3	24	12
11	3	25	13

At the extremities, the furcal segments carry each on the inner side a long bristle half as long again as the furca, and at the outer margin a rather long unfeathered bristle, and one short and thick bristle, with a fourth external bristle situated a little distance from the distal margin. The exopodite of the 3rd pair of feet is the broadest and longest, the last segment as long as the first two, the endopodite only half its length. The last joint of the exopodite has only one marginal spine at the distal end.

The 4th feet have a short exopodite of 3 segments but no endopodite, though there is one bristle externally on the second basal.

The anterior antenna of 6 joints has the 4th joint nearly as long as the two last. The posterior antenna with 2 long basal joints and a short endopodite of three segments, the last modified into a claw, with stout hook bristles on the two first segments; the 2nd basal $3\frac{1}{2}$ times as long as broad, with the distal margin armed with four delicate long curved spines; the bristle of the 1st basal longer than that of the 2nd and both with marginal widely separated feathers. The posterior foot-jaw with broad claw-like 2nd joint with a stout spine at the distal extremity, the endopodite a basal joint and claw, with small inner bristle. See Pl. XCIX. figs. 4, 5, 6, 7, 8, 9, 10, 11.

This *Corycæus* closely agrees with Brady's and Willemoes-Suhn's *pellucidus* (=*megalops*), rather smaller than the former, the same size as the latter, differing from the former in the denticulation of the posterior antennal 2nd joint and apparently in the square-shaped abdomen with frontal knob. Probably Brady's description and figures embrace at least two different species, one of them agreeing with Willemoes-Suhn's specimens.

Very similar in many respects to Giesbrecht's *C. gibbulus*, it at once differs from this species in the proportions of the abdomen and furca (and shape of the former) and the basal joint of the posterior antenna but probably the species is variable.

As remarked by Willemoes-Suhn, the animal is distinguished by the large plum-jelly coloured eyes, and the amount of cobalt blue pigment scattered through the body and limbs. Not one of the very numerous specimens (in the Maldive collection) was observed without the bunch of clear, transparent (? spermatophore) processes attached to the genital openings. It is the commonest *Corycæus* in this collection.

Cleve has described[1] what he considers to be the ♂ of *C. gibbulus*, Giesb., and which presents certain differences in the shape of the abdomen and length of furcal segments (7 times as broad as long according to Cleve) and in the structure of the posterior antenna.

97. *Corycæus gibbulus*, Giesb.

[1] "Plankton from the Indian Ocean and Malay Archipelago," *Kong. Svenska Vetenskaps Akad. Handl.* B. xxxv. No. 5.

98. *Corycæus carinatus*, Giesb.

99. *Corycæus gracilicaudatus*, Giesb.

100. *Corycæus ?amazonicus*, Dahl, *loc. cit.* (vel nov.).

♀ 1 mm. long. Abdomen of two segments. Relative length of Ab. 1, ab. 2, furca, 7 : 8 : 9, with bristles on the genital segment. The lateral processes of Th. 3 and 4 are short, the endopodite of the 4th feet is a longer 'tap' joint than in other species, and carries two rather long feathered bristles, the 2nd basal behind the origin of the endopodite forming a sharp angular bend. All the endopodites of the feet are short, the 3rd joint of the exopodite of the 2nd foot long with long marginal setæ and a long spine at the apex, with the point bent inwards: in the other feet this spine is straight.

The bristle of the 2nd basal of the posterior antenna is not more than half the length of that of the 1st basal, and shorter than the distal hook. This Copepod has some resemblance to *C. tenuis* and *C. lubbockii*, the relative lengths of the abdominal segments and furca however are different:

	Ab. 1	Ab. 2	Furca
C. tenuis	7	4	8
C. lubbockii	9	4	11
C. amazon. (?)	7	8	9

In both of these species the furca is double or over the length of the anal segment, the latter only half the length of the genital. In this species the proportionate length of the three segments is more nearly equal. Under the diagnosis of *C. lubbockii* Dahl mentions a small hook on the female genital segment (genital openings) which is certainly absent in this species. Without figures, which are absent in Dahl's article, it is impossible to refer this Copepod to any of those of the group mentioned by him with certainty (*C. amazonicus, asiaticus, minimus, anglicus, tenuis, lubbockii*), but it agrees more with *amazonicus* than any other, in the short second antennal bristle, 2-segmented abdomen, endopodite of 4th feet with two bristles, anal segment longer than the genital. The proportions of genital and anal segments entirely exclude *C. asiaticus* and *minimus* (Dahl), and it probably should be regarded as a new species.

Gen. *Sapphirina* Thompson.

101. *Sapphirina ovatolanceolata* (Dana).

102. *Sapphirina nigromaculata* (Claus).

103. *Sapphirina opalina* (Dana).

104. *Sapphirina metallina* (Dana).

105. *Sapphirina intestinata* (Giesb.).

Gen. *Oncœa* Philippi.

106. *Oncœa conifera* (Giesb.).

107. *Oncœa media* (Giesb.).

108. *Oncœa mediterranea* (Claus).

109. *Oncœa venusta* (Philippi).

By far the commonest *Oncœa* in this collection is *O. venusta,* which occurs in nearly all samples. The other three are rare. These four forms are also recorded by Cleve from the Indian Ocean and Malay Archipelago.

Gen. *Lubbockia* Claus.

110. *Lubbockia squillimana* (Claus).

Gen. *Miracia* Dana.

111. *Miracia efferata* (Dana).

Gen. *Setella* Dana.

112. *Setella gracilis* (Dana).

Gen. *Copilia* Dana.

113. *Copilia mirabilis* (Dana) (= *Sapphirinella stylifera* of Brady).

Gen. *Clytemnestra* Dana.

114. *Clytemnestra scutellata* (Dana).

Gen. *Ectinosoma* Brady.

115. *Ectinosoma atlantica* (Brady).

Six examples only occurred of this widely distributed species. It is not mentioned among the Malay Copepods by Cleve, but occurs in the Antarctic region (Giesbrecht's report on the Belgica collection) as well as in the extreme north.

Gen. *Saphirella* T. Scott.

116. *Saphirella tropica* (nov. sp.), *S. abyssicola.* T. Scott, *Tr. Linn. Soc.* Vol. VI. Feb. 1893.

Under this name was described by Scott a strange Copepod from the Gulf of Guinea, taken at 260 fathoms, to which this author gave the name *S. abyssicola.*

One similar species was found in the Maldive collection, whole length 1·2 mm., greatest breadth of the cephalothorax ·3, and of the abdomen ·2 mm. The forebody is composed of 3 segments, the first pointed in front and three times as long as the next two segments, the second expanded laterally into strong wings like a *Corycœus,* the third narrower and with rounded margins bearing laterally a pair of simple 5th feet, and with 2 transverse chitin lines perhaps representing segmental division. The relative length of the three thoracic segments is 15 : 2 : 3. The first abdominal segment is longer than broad, and with pointed expansions at the distal lateral angles; the genital opening is in the middle of the segment, the latter forming a flap. The second abdominal segment long and comparatively narrow with straight and parallel lateral margins, is narrowed above where it joins the genital segment. A pair of very short furcal segments bear a very short lateral bristle and a pair of long stylet-shaped bristles longer than the second abdominal segment. The animal is remarkable in possessing in the thorax and abdomen altogether only 6 segments.

Anterior antennæ short and of 5 segments, comparatively

1	2	3	4	5
5	8	4½	4½	5

The third and fourth segments with long setæ, the 5th with 3 long and 4 short setæ.

The posterior antennæ each of 3 joints and one ramus only, the segments nearly equal in length, the 1st and 2nd with one marginal seta each, the last joint with outer and inner lobe, the inner margin denticulated, the outer with three short setæ, the lobes carrying respectively 5 (inner) and 4 (outer) bristles, especially broad and curved in the latter. The mandibles with strong conical tooth, under which is a stout broad plumose seta and internal to this two strong pointed plumose setæ. The posterior foot-jaw consists of two basal joints and a short and narrow endopodite of indistinctly two joints, the second basal much longer than the first, convex in the middle and with three setæ, short but stout; the first joint with three bristles at the distal end, two short and narrow, one longer with widely separated plumes. The short endopodite with 2 claw-like bristles, the innermost much longer than the other, the outer with a few lateral long spines.

The swimming feet are reduced to three pairs, only the anterior two pairs of which are freely adapted for swimming. Each biramous, composed of an outer and inner segment only, foliaceous, the exopodite with 5 broad lancet-shaped conspicuous spines, externally the two apical longer than the three marginal, and three long feathered setæ on the inner margin, the proximal part of this segment feathered on the inner side. The inner (endopodite) segment is nearly the same length and breadth as the exopodite, with seven simple long feathered setæ. (Scott describes the inner branch as a segment carrying dagger-shaped marginal spines like the outer segment. This is certainly not the case in the Maldive specimen, where the exopodite and endopodite segments had the usual structure, viz. marginal spines on the former, plain setæ on the latter.)

The 2nd pair of feet completely resemble the first. (Scott describes his species as having 'the three dagger-shaped spines on the inner branch replaced by plumose setæ.')

The 5th feet are represented by a short peduncle on each side carrying one external short simple bristle and one dagger-shaped spine of the same length internally, neither being longer than the first abdominal segment. Scott's specimen was apparently without any 5th pair. See Pl. XCIX. figs. 12, 13, 14, 15, 16, 17.

Clearly this Copepod is not identical with Scott's Gulf of Guinea species, though closely allied to it and of the same genus.

In Brady's monograph "The Marine Copepoda of N. Zealand" (*Trans. of the Linn. Soc. of London*, Vol. xv. Part II. No. 1, Aug. 1899) is described a new genus *Paurocopa*, in the description of which Brady remarks "the specimen described by Mr T. Scott under the generic name *Saphirella* seems to be, except as to the mouth organs, very similar to the present."

The shape of the body, the second thoracic segment and the abdomen and the mouth organs do not appear to be similar, and probably these two genera will be found to be different when more examples are submitted to examination. The Indian Ocean specimen certainly differs from both in the possession of 3 pairs of feet. Unfortunately only one specimen was found.

Gen. *Dactylopus* Claus.

117. *Dactylopus maldivensis*, nov.

♀, body of 11 segments, furca twice as broad as long, head with large broad spoon-like frontal process. ·9 mm. long.

Anterior antennæ of 9 segments, the basal four thick, the 4th with a long sensory process, the joints distally of this, small and narrow, the last one the largest.

Posterior antennæ with the large ramus of three joints, the second rather the largest, the last joint with a row of short marginal spines, two long distal marginal spines, and 5 apical broad bristles: exopodite slender, of 3 segments, the middle one very short, basal with one long distal marginal spine, last joint with 3 short terminal bristles.

Mandible palp of an ovoid basal much longer than broad and 2 rami, the inner rather longer than broad, square at the end, and with 6 + 2 bristles, the outer smaller and narrower, of two distinct joints, rather square, and with 5 terminal bristles; basal with 3 distal marginal bristles.

Masticatory plate with very strong teeth, outer trifid, next only little smaller and bifid, inner 4 smaller, innermost 3 rather pointed. One spine-like bristle and one rather long thick feathered bristle (below it) on inner margin.

Anterior foot-jaw with setigerous lobes, and one hook bristle on the 5th (?).

Posterior foot-jaw a claw, the middle joint with both margins convex, the inner armed with a row of fine teeth or spines and 2 rather long setæ, the end joint a strong claw bristle and two fine setæ internal to it.

The swimming feet except the 5th pair are biramous, each ramus with 3 joints; one foot of the 1st pair being however quite abnormal. The exopodite in this is of 4 distinct segments (as shown in the figure), the normal foot has the exopodite shorter than the 1st joint of the endopodite (seven-eights as long), the middle joint one-third longer than either the 1st or 3rd. Setæ 1, 1, 5, those of the last joint progressively longer from the outside inwards, and bearing strong claw-like bristles.

The 1st joint of the endopodite four times as long as broad, the inner margin with stiff hairs, the two end joints short, the proximal one with a long claw bristle and one inner marginal fine seta, and four spines at apex and inner margin, the distal with one strong claw bristle and two fine apical setæ.

2nd pair, with exop. 3, about twice as long as exop. 1 or 2, which are equal.

End. 1 < end. 2 < end. 3. End. 2 very broad, with distal margin ending on inner side in a short and on the outer side in a very long spine.

End. 1 with distal margins ending similarly but with outer spine longer than inner.

End. 3 square at end, with one marginal and 4 apical setæ, and one long rather broad spine at outer margin. Outer margins of end. 2 and 3 with short thick teeth. Exopodite with long and strong marginal spines, each with smaller spine internal to it. Inner distal margin of 2nd joint ending in stout spine, of 1st joint in short thick feathered seta. Spines of outer margins and apex, 1, 1, 4; apex and inner margin of last joint with 3 fine setæ.

Basal joints broad, 1st with strong thick short feathered bristle on the outer distal margin; 2nd ending in stout spine at the inner distal margin.

3rd pair of unequal size, on one side exop. and end. about equal length, on other exop. > end. In the former, exop. 3 is one-third longer than exop. 2 and has 2 marginal spines, one apical, and 3 inner marginal setæ; in the latter (unequal side) exop. 3 is twice as long as exop. 2, and has 3 outer marginal spines, one apical, and 3 inner marginal setæ. In the anomalous foot the marginal bristles of the inner side of the endopodite are 1, 1, 5.

The 4th foot is broken, but the inner marginal bristles of the endopodite are 1, 1, 4; the last joint with an apical spine at the outer margin.

5th pair, each of 2 foliaceous branches; inner ramus as broad as long, with 4 long and one fine apical and marginal setæ; the inner margin with stiff hairs, the outer upper marginal prolongation with one long seta; the outer ramus longer than broad, with 6 apical setæ.

The characters of the mandibles, the absence of marginal bristle on the end. 1 of the 1st feet (replaced by strong distal claw bristle), the 5th feet, and segmentation of the anterior antennæ are points of difference between this and any of the Ceylon species of *Dactylophusia*, and it seems to more nearly approach to *D. stromii* than to *D. tisboides* of European species. The very anomalous forms of the 1st and 2nd feet are probably accidental malformations.

See Pl. XCIX. figs. 34, 35, 36, 37, 38, 39, 40, 41.

Gen. *Peltidium* Philippi.

118. *Peltidium elegans*, nov. sp.

Whole length 1·1 mm., and in the broadest part ·6 mm. wide; head produced anteriorly into square ended process; body of six segments, the last on each side produced downwards and pointed. Furca not visible from the dorsal surface, only the long setæ, the segments quite hidden under the conical projection in the middle of the last segment. The chitin strongly reticulated in very regular manner. Furcal segments (from ventral aspect) twice as long as broad. Anterior antennæ short, with very thick basal joints, and of 9 joints, the basal three very large, the distal each successively smaller than the preceding, densely clothed with setæ, and with a long sensory process on the 4th segment. Posterior antennæ of two rami, inner of 4 segments, 2 short basals, long 1st and 2nd endopodite segments; outer ramus short and thin and of two segments only (see figure). Posterior foot-jaw claw shaped, 2nd basal with marginal row of fine teeth, end claw (endopodite) rather short but stout and with one thin basal bristle.

First pair of legs, with broad basals, exopodite of two segments, the 2nd longer than the 1st, and with 2 short strong claws; the endopodite of 2 segments, the first very broad and with marginal external process haired both sides and as long as the next joint, the last joint small, with 2 thick very short processes distally and 3 bristles.

2nd to 4th pairs of feet with 3-jointed exopodites and endopodites; marginal spines of the latter long and thin. Fifth pair quite hidden on the ventral surface of the chitinous integument, each of only one segment, with 3 long internal bristles, the distal one only feathered, 2 apical and one outer marginal bristle. See Pl. XCIX. figs. 21, 22, 23, 24, 25, 26, 27.

In comparing this specimen (the only one which could be found) with the 5 species mentioned and drawn in Thompson and Scott's monograph and with *Reticulina aurivillii* Cleve ("Plankton from the Indian Ocean and Malay Archipelago," p. 50), it is obviously not identical with any of those six species. In both Cleve's, and Scott and Thompson's, descriptions and figures, the outer ramus of the 1st feet is called the inner and *vice versâ*. The longer thinner foot ending in claws is the outer (or exopodite), and is figured correctly in Claus's

monograph (*Die Peltidien*) and in Brady's description of the genus *Peltidium* (*Cop. of the Brit. Isl.* p. 159).

In all the Ceylon species the anterior antenna is said to be 6 to 7 jointed, the same in Cleve's Malay species (*Reticulina aurivillii*). The 9 segments are distinct in the Maldive specimen, with a clear break in the chitin on each side of each segment, and the 9th or last segment though extremely small is probably present; thus it agrees with Philippi's original description of the genus as to segmentation of this organ.

For the three genera created by Claus[1], 1 *Alteutha*, 2 *Eupelte*, 3 *Oniscidium*, the number of segments of the anterior antenna is 8 or 9; the Ceylon species therefore differ greatly in this important particular from any known species of *Peltidium*. The Maldive specimen appears to agree more with Claus's subgenus *Oniscidium* than the others, and is characterised by the reticulation of the chitinous skeleton, the structure of the 1st feet, and the very short abdomen completely hidden in the dorsal aspect; and differs as before said in the segmentation of the antennæ from any of Thompson and Scott's species.

Gen. *Porcellidium* Claus.

119. *Porcellidium tuberculatum*, nov. sp.

Body rounded, seven-ninths as broad as long, whole length ·60 mm.; carapace dotted over with closely set tubercles, and the whole bright carmine colour.

Anterior antennæ 6-jointed.

1st pair of feet and mouth organs very like the same organs in *P. fimbriatum*.

5th feet long and rather narrow, ending in a blunt point with two apical short setæ, and a short spine about the middle of the external margin.

Abdomen very short, and furcal segments about $2\frac{1}{2}$ times as long as broad, pointed apically, with one apical seta and two setæ at the distal external margin. See Pl. XCIX. figs. 28, 29, 30.

Of Thompson and Scott's species this animal bears most superficial resemblance to *P. acuticaudatum*, so far as the furcal segments show; and of British species to *P. tenuicauda*, but the form of the body especially is very different to either.

Gen. *Euterpe* Claus.

120. *Euterpe acutifrons*.

Two or three specimens only occurred of this species, which appears to have a pretty wide distribution. Pl. XCIX. figs. 18, 19, 20.

[1] *Loc. cit.*

EXPLANATION OF PLATES.

PLATE XCVI.

FIG. 1. *Calanus robustior*, ♀. Whole animal.
FIG. 2. „ „ ♀. Abdomen and last thoracic segment: side view.
FIG. 3. „ „ ♀. 1st foot.
FIG. 4. „ „ ♀. 2nd foot.
FIG. 5. „ „ ♀. Posterior foot-jaw.
FIG. 6. „ „ ♀. Maxilla.
FIG. 7. *Paracalanus parvus*, ♀. Furcal segments and tail.
FIG. 8. „ „ ♀. 1st basal of 4th foot (specimen from the Faroe Channel).
FIG. 9. „ „ ♀. 5th feet.
FIG. 10. „ „ ♀. 4th foot (example from Maldives).
FIG. 11. „ „ ♀. Last 4 joints of the anterior antenna.
FIG. 12. „ *aculeatus*, ♀. Anterior antenna.
FIG. 13. „ „ ♀. 4th foot.
FIG. 14. „ „ ♀. 5th foot.
FIG. 15. „ „ ♀. Anal segment, furca and tail.
FIG. 16. „ *parvus*, ♂. 5th feet.
FIG. 17. *Euchirella bella*, ♀. Abdomen and tail.
FIG. 18. „ „ ♀. 4th foot, basal segment.
FIG. 19. „ „ ♀. Whole animal, side view.
FIG. 20. „ „ ♀. Posterior antenna.
FIG. 21. *Calanus vulgaris*, var. *plumosus*. One of the tail bristles.
FIG. 22. „ „ „ Abdomen, with branched tail bristles.
FIG. 23. *Paracalanus aculeatus*, var. *plumosus*.
FIG. 24. *Pleuromamma indica*, ♂. Abdomen.
FIG. 25. „ „ ♂. Portion of the anterior antenna.
FIG. 26. „ „ ♂. 5th feet.
FIG. 27. „ *xiphias*, ♀. 1st foot.
FIG. 28. „ *abdominalis*, ♀. Portion of the anterior antenna (specimen from Faroe).
FIG. 29. „ „ ♀. Head, dorsal view (specimen from Faroe).
FIG. 30. „ „ ♀. Head, lateral view „ „ „
FIG. 31. „ *indica*, ♂. Portion of anterior antenna.
FIG. 32. „ „ ♂. Head, dorsal.

Fig. 33. *Pleuromamma indica*, ♂. Head, lateral.
Fig. 34. „ *robusta*, ♀. Portion of the anterior antenna (specimen from Faroe Channel).
Fig. 35. „ „ ♀. Head, dorsal (specimen from Faroe Channel).
Fig. 36. „ „ ♀. Head, lateral „ „ „
Fig. 37. „ *xiphias*, ♀. Portion of anterior antenna.
Fig. 38. „ „ ♀. Head, dorsal.
Fig. 39. „ „ ♀. Head, lateral.
Fig. 40. *Candace tuberculata*, ♂. Last thoracic segment and abdomen.
Fig. 41. „ „ ♂. 5th feet.
Fig. 42. „ „ ♂. Portion of the 5th foot in lateral aspect.
Fig. 43. „ „ ♂. Whole animal.
Fig. 44. „ „ ♂. Last thoracic segment and ab. 1 and 2 (enlarged).
Fig. 45. *Haloptilus spiniceps*, ♂. Whole animal, dorsal.

PLATE XCVII.

Fig. 1. *Acrocalanus longicornis*, ♀. Cephalothorax, dorsal.
Fig. 2. „ *gracilis*, ♀. „ „
Fig. 3. „ *gibber*, ♀. „ „
Fig. 4. „ *monachus*, ♀. „ „
Fig. 5. „ *gardineri*, ♂. Side view.
Fig. 6. „ *longicornis*, ♀. „ „
Fig. 7. „ *gracilis*, ♀. „ „
Fig. 8. „ *gibber*, ♀. „ „
Fig. 9. „ *monachus*, ♀. „ „
Fig. 10. „ *gardineri*, ♂. 1st foot.
Fig. 11. „ *longicornis*, ♂. 1st foot.
Fig. 12. „ „ ♀. 2nd foot.
Fig. 13. „ „ ♀. 3rd foot.
Fig. 14. „ *gardineri*, ♂. 3rd foot.
Fig. 15. „ „ ♂. 2nd foot.
Fig. 16. „ „ ♂. 5th foot.
Fig. 17. „ „ ♂. Last exopodite segment of 4th foot.
Fig. 18. „ „ ♂. Mandible palp.
Fig. 19. „ „ ♂. Maxilla.
Fig. 20. „ „ ♂. Posterior antenna.
Fig. 21. „ „ ♂. Posterior foot-jaw.

FIG. 22. *Acrocalanus longicornis*, ♀. 4th foot.
FIG. 23. „ „ ♂. Side view.
FIG. 24. „ „ ♂. 5th foot.
FIG. 25. „ *gracilis*, ♂. Side view.
FIG. 26. „ „ ♂. 5th foot.
FIG. 27. „ *monachus*, ♂. Side view.
FIG. 28. „ „ ♂. 5th foot.
FIG. 29. *Calanus pauper*, ♂. 1st foot, basals enlarged.
FIG. 30. „ „ ♂. 5th foot, doubly flexed.
FIG. 31. „ „ ♂. Side view.
FIG. 32. „ „ ♂. 1st foot.
FIG. 33. „ „ ♂. 5th feet.
FIG. 34. „ „ ♂. Posterior foot-jaw.
FIG. 35. „ „ ♂. Abdomen.
FIG. 36. „ *minor*, ♂. 5th foot (right basal).
FIG. 37. „ „ ♂. 5th pair of feet.
FIG. 38. „ „ ♂. 5th foot of right side, basals and endopodite.
FIG. 39. „ *vulgaris*, ♂. 5th foot.
FIG. 40. „ *darwinii*, ♂. „
FIG. 41. „ *caroli*, ♂. „

PLATE XCVIII.

FIG. 1. *Centropages orsinii*, ♂. Side view.
FIG. 2. „ *elongatus*, ♀. 5th foot.
FIG. 3. „ „ ♀. Abdomen.
FIG. 4. „ *orsinii*, ♂. Anterior antenna.
FIG. 5. „ „ ♀. Lateral view.
FIG. 6. „ *calaninus*, ♀. Abdomen, ventral.
FIG. 7. „ *gracilis*, ♀. „ „
FIG. 8. „ *orsinii*, ♂. 2nd basal of 4th foot.
FIGS. 9, 10. „ *elongatus*, ♂. 5th feet.
FIGS. 11, 12. „ *orsinii*, ♂. „
FIG. 13. „ „ ♀. „
FIG. 14. „ *elongatus*, ♂. 5th foot enlarged and lateral aspect of exopodite.
FIG. 15. „ *calaninus*, ♀. Abdomen, lateral view.
FIG. 16. *Labidocera detruncata*, ♂. 5th feet.
FIG. 17. „ *wollastoni*, ♀. Abdomen, lateral.

Fig. 18. *Labidocera minuta*, ♀. Abdomen, lateral.
Fig. 19. „ *detruncata*, ♀. Abdomen, ventral.
Fig. 20. „ *laevidentata*, ♂. 5th feet.
Fig. 21. „ *detruncata*, ♀. Abdomen (? variety).
Fig. 22. „ *kröyeri*, ♀. Abdomen.
Fig. 23. „ „ ♀. Abdomen, dorsal.
Fig. 24. „ *minuta*, ♀. Abdomen, ventral.
Fig. 25. „ „ ♀. 5th feet.
Fig. 26. „ *laevidentata*, ♂. 5th feet.
Fig. 27. „ „ ♂. 5th feet, lateral view.
Fig. 28. „ „ ♂. Dorsal view.
Fig. 29. „ *minuta*, ♂. Last thoracic segment and abdomen, dorsal.
Fig. 30. „ *wollastoni*, ♀. 5th feet.
Fig. 31. „ „ ♂. „
Fig. 32. „ *minuta*, ♂. „
Fig. 33. „ *kröyeri*, ♀. „
Fig. 34. „ *detruncata*, ♀. „
Fig. 35. „ *wollastoni*, ♂. Anterior antenna.
Fig. 36. „ *detruncata*, ♂. „ „
Fig. 37. „ *minuta*, ♂. „ „
Fig. 38. „ *laevidentata*, ♂. „ „
Fig. 39. *Pontellopsis krämeri*, ♀. 5th feet.
Fig. 40. „ „ ♀. Abdomen.
Fig. 41. „ „ ♀. Posterior antenna.

PLATE XCIX.

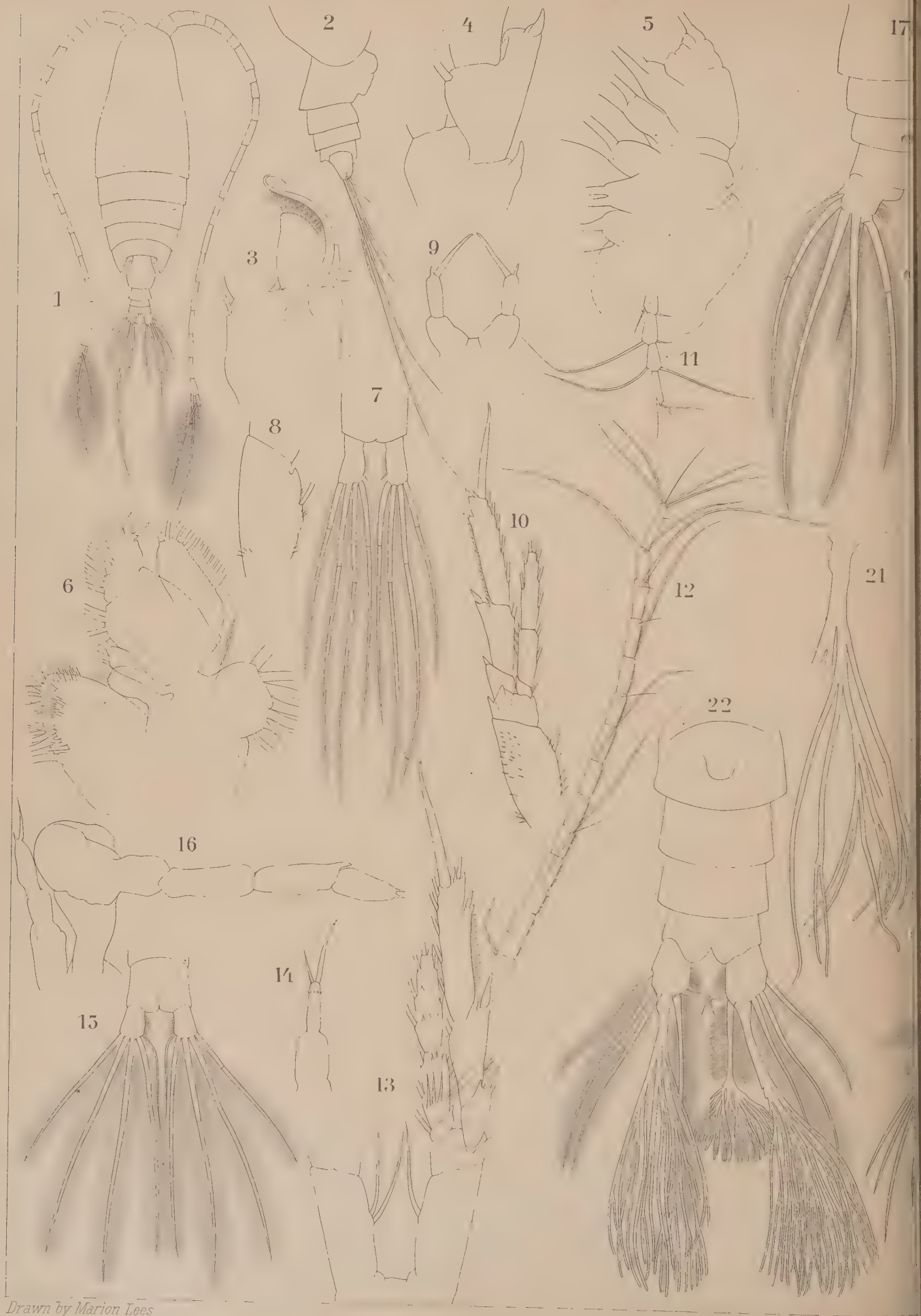
Fig. 1. *Pontellopsis armata*, ♀. Whole animal, side view.
Fig. 2. „ „ ♀. Last thoracic segment and abdomen (ventral).
Fig. 3. „ „ ♀. 5th foot.
Fig. 4. *Corycæus pellucidus*, ♀. Whole animal, dorsal.
Fig. 5. „ „ ♀. Whole animal, side view.
Fig. 6. „ „ ♀. Posterior foot-jaw.
Fig. 7. „ „ ♀. Posterior antenna.
Fig. 8. „ „ ♀. 3rd foot.
Fig. 9. „ „ ♀. 4th foot.
Fig. 10. „ „ ♀. Cushion of the 1st abdominal segment.

Fig. 11. *Corycæus pellucidus*, ♀. Anterior antenna.
Fig. 12. *Saphirella tropica*, ♀. Portion of cephalothorax and abdomen.
Fig. 13. „ „ ♀. Posterior antenna.
Fig. 14. „ „ ♀. Anterior antenna.
Fig. 15. „ „ ♀. 1st foot.
Fig. 16. „ „ ♀. Mandible palp (?).
Fig. 17. „ „ ♀. Maxilla and ? anterior foot-jaw.
Fig. 18. *Euterpe acutifrons*, ♀. Dorsal view.
Fig. 19. „ „ ♀. Side view of head.
Fig. 20. „ „ ♀. 5th pair of feet.
Fig. 21. *Peltidium elegans*, ♀. Dorsal view.
Fig. 22. „ „ ♀. Last cephalothoracic segment and abdomen (ventral).
Fig. 23. „ „ ♀. 2nd foot.
Fig. 24. „ „ ♀. Posterior antenna.
Fig. 25. „ „ ♀. Anterior antenna.
Fig. 26. „ „ ♀. 1st foot.
Fig. 27. „ „ ♀. Posterior foot-jaw.
Fig. 28. *Porcellidium tuberculatum*, ♀. Whole animal (dorsal)
Fig. 29. „ „ ♀. 5th foot.
Fig. 30. „ „ ♀. 1st foot.
Fig. 31. *Thaumaleus tropicus*, ♀. 5th feet.
Fig. 32. „ „ ♀. Whole animal, side view.
Fig. 33. „ „ ♀. Abdomen (ventral).
Fig. 34. *Dactylopus maldivensis*, ♀. Abdomen.
Fig. 35. „ „ ♀. 1st foot.
Fig. 36. „ „ ♀. „
Fig. 37. „ „ ♀. 5th foot.
Fig. 38. „ „ ♀. Anterior antenna.
Fig. 39. „ „ ♀. Mandible and palp.
Fig. 40. „ „ ♀. Posterior antenna.
Fig. 41. „ „ ♀. 2nd foot.
Fig. 42. *Oithona rigida*, ♀. Dorsal view.
Fig. 43. „ *robusta*, ♀. „
Fig. 44. „ *tropica*, ♀. „
Fig. 45. „ „ ♀. 1st foot.
Fig. 46. „ „ ♀. 2nd foot.

Fig. 47. *Oithona tropica*, ♀. 3rd foot.
Fig. 48. „ „ ♀. 4th foot.
Fig. 49. „ *linearis*, ♀. Dorsal view.

PLATE C.

Fig. 1. *Euchaeta concinna*, ♀. Last cephalothoracic segment and abdomen.
Fig. 2. „ „ ♀. Genital segment, ventral.
Fig. 3. „ „ ♀. „ „ lateral, right side.
Fig. 4. „ „ ♀. 2nd foot.
Fig. 5. „ „ ♀. Genital segment, lateral, left side.
Fig. 6. „ „ ♀. Exopodite of 1st foot.
Fig. 7. „ *marina*, ♀. Whole animal, dorsal.
Fig. 8. „ „ ♀. Exopodite of 2nd foot.
Fig. 9. „ „ variety, ♀. Genital segment, ventral.
Fig. 10. „ „ ♀. 1st foot, exopodite.
Fig. 11. „ „ ♀. Genital segment, right side, lateral.
Fig. 12. „ *indica*, ♀. Genital segment, ventral.
Fig. 13. „ „ ♀. „ „ lateral, left side.
Fig. 14. „ „ ♀. „ „ „ right side.
Fig. 15. „ „ ♀. 1st foot, exopodite.
Fig. 16. „ „ ♀. 2nd foot, exopodite.
Fig. 17. „ *marina*, ♀. Genital segment, ventral.
Fig. 18. „ „ ♀. „ „ lateral, left side.
Fig. 19. „ „ ♂. 5th foot.
Fig. 20. „ „ ♂. „
Fig. 21. „ *norvegica*, dichotomous branching of tail setæ.



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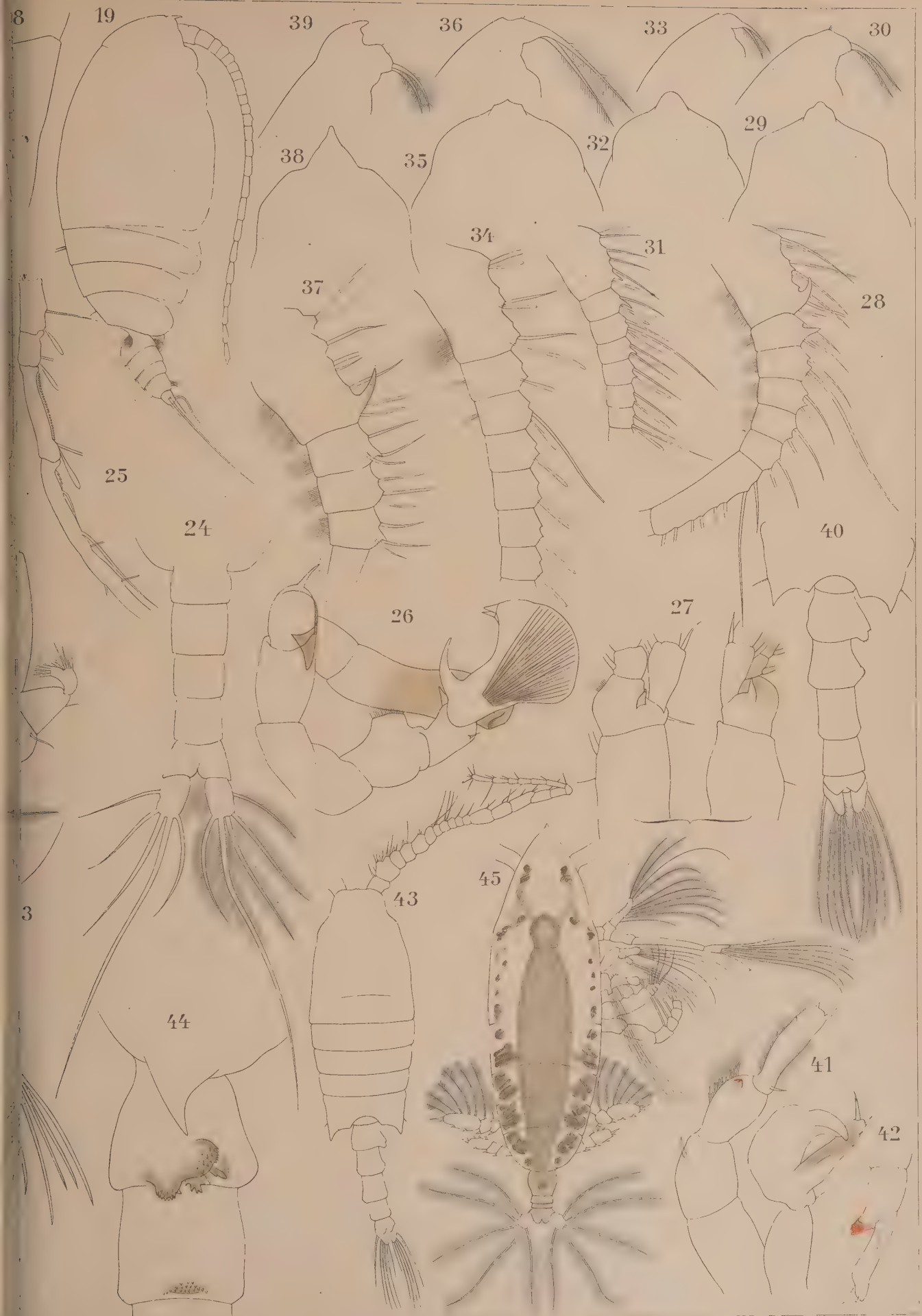

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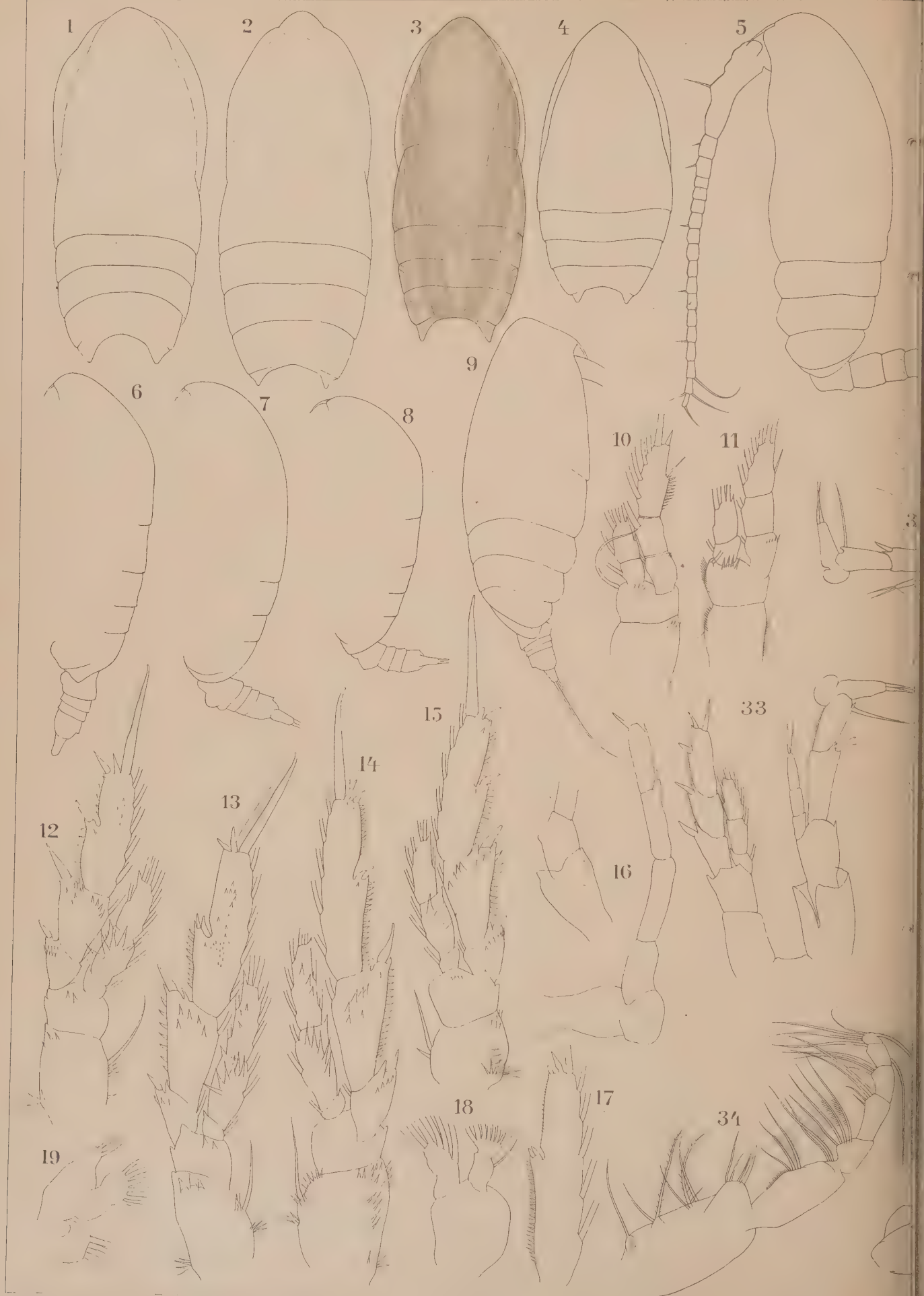

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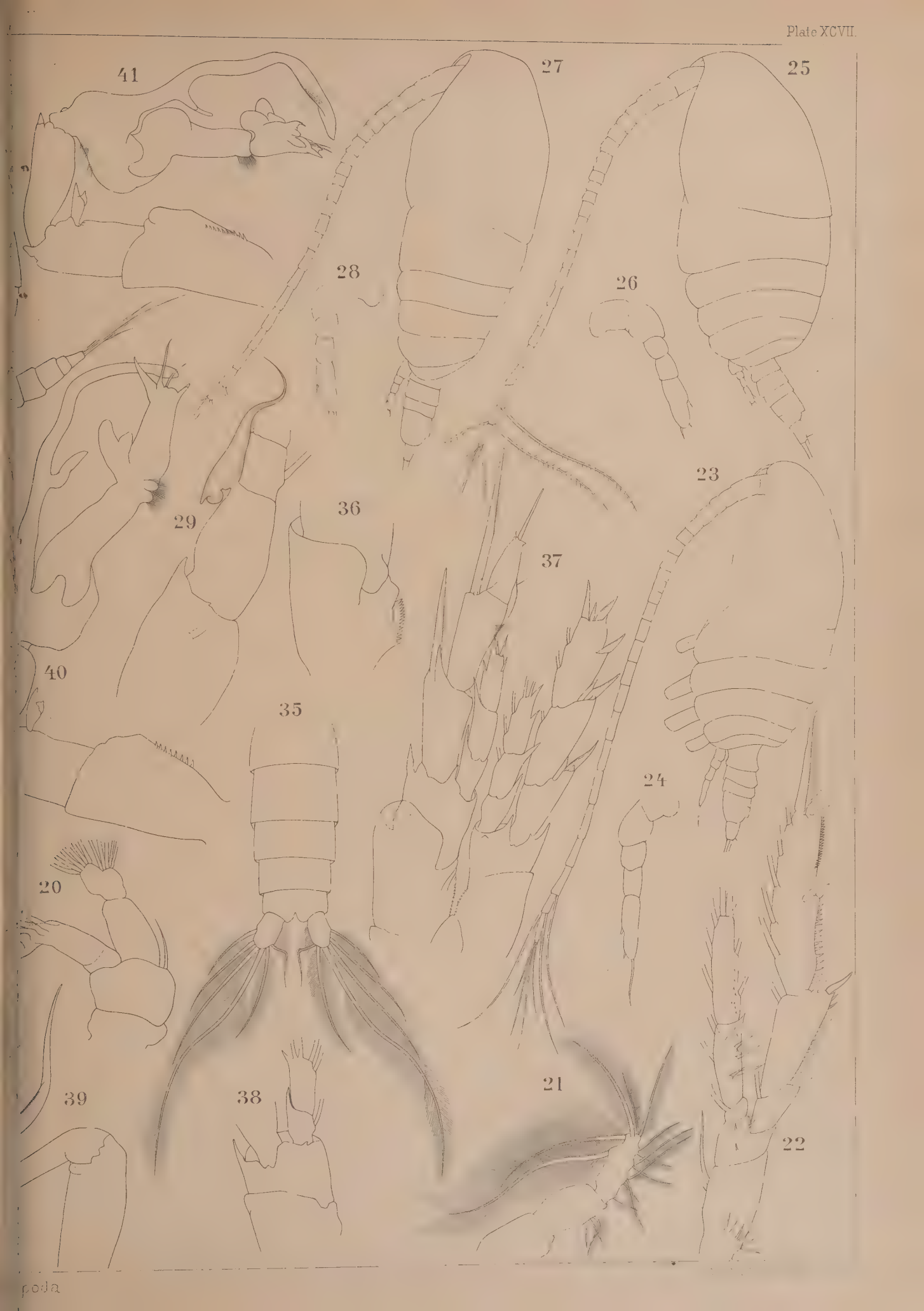
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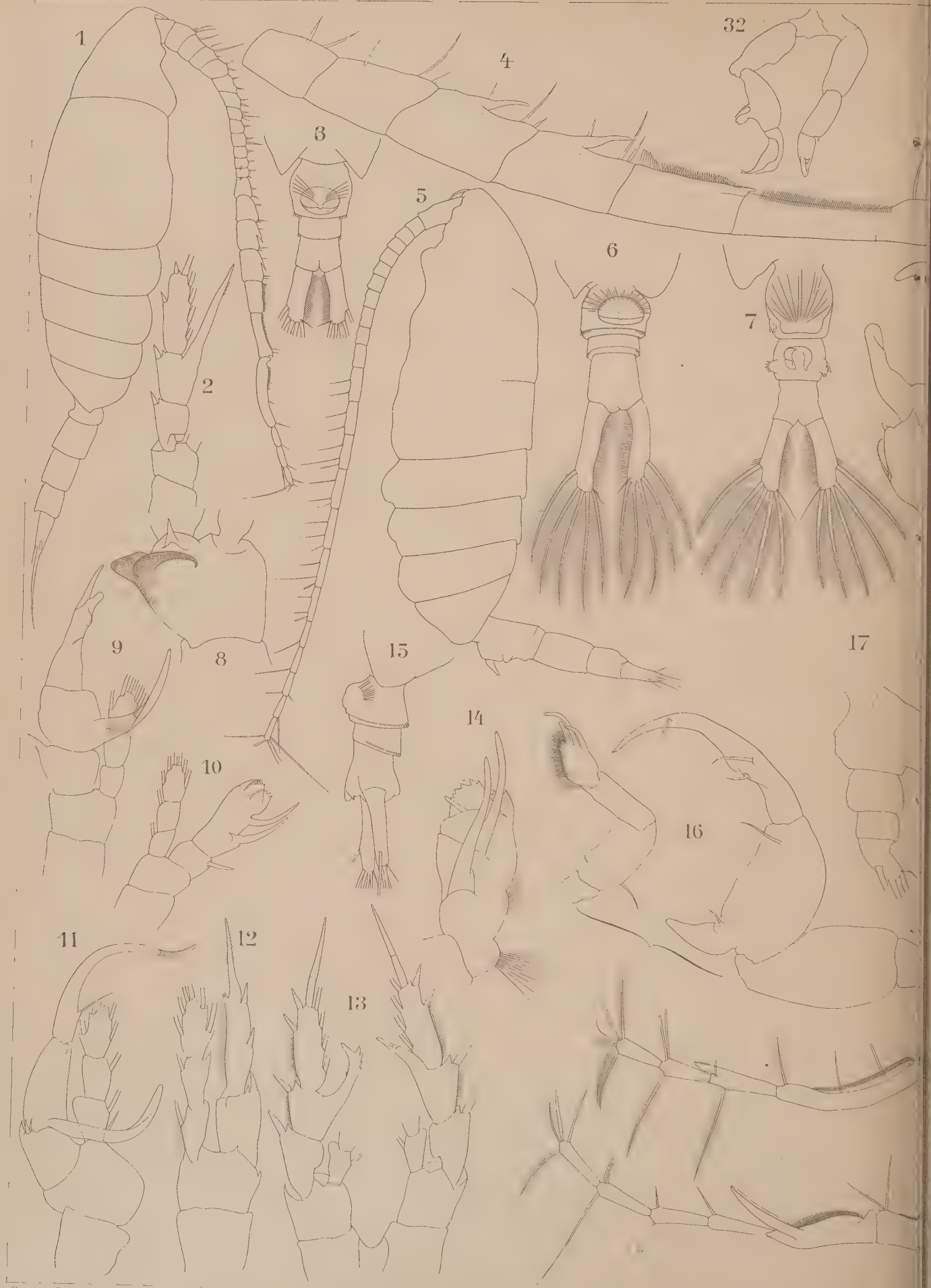

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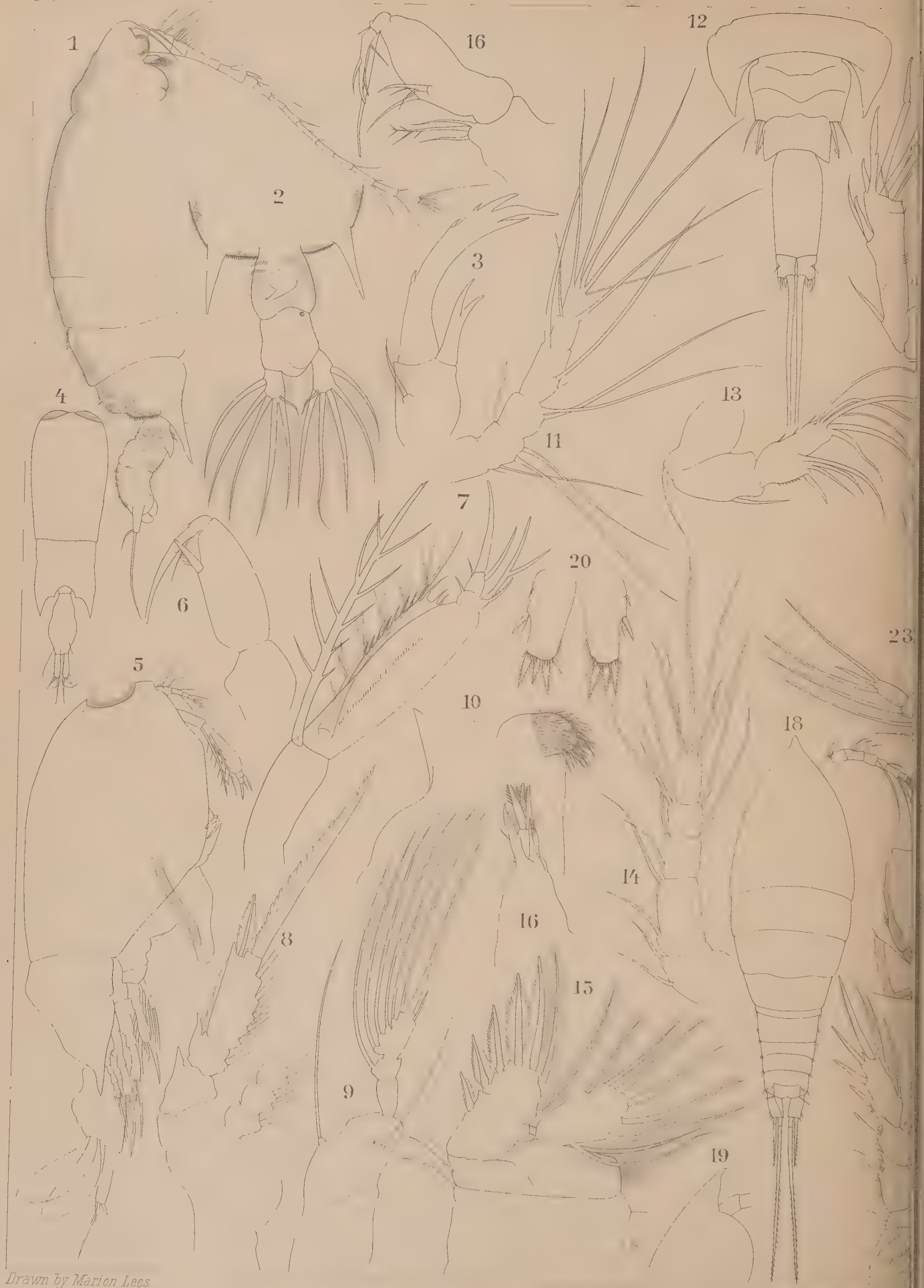

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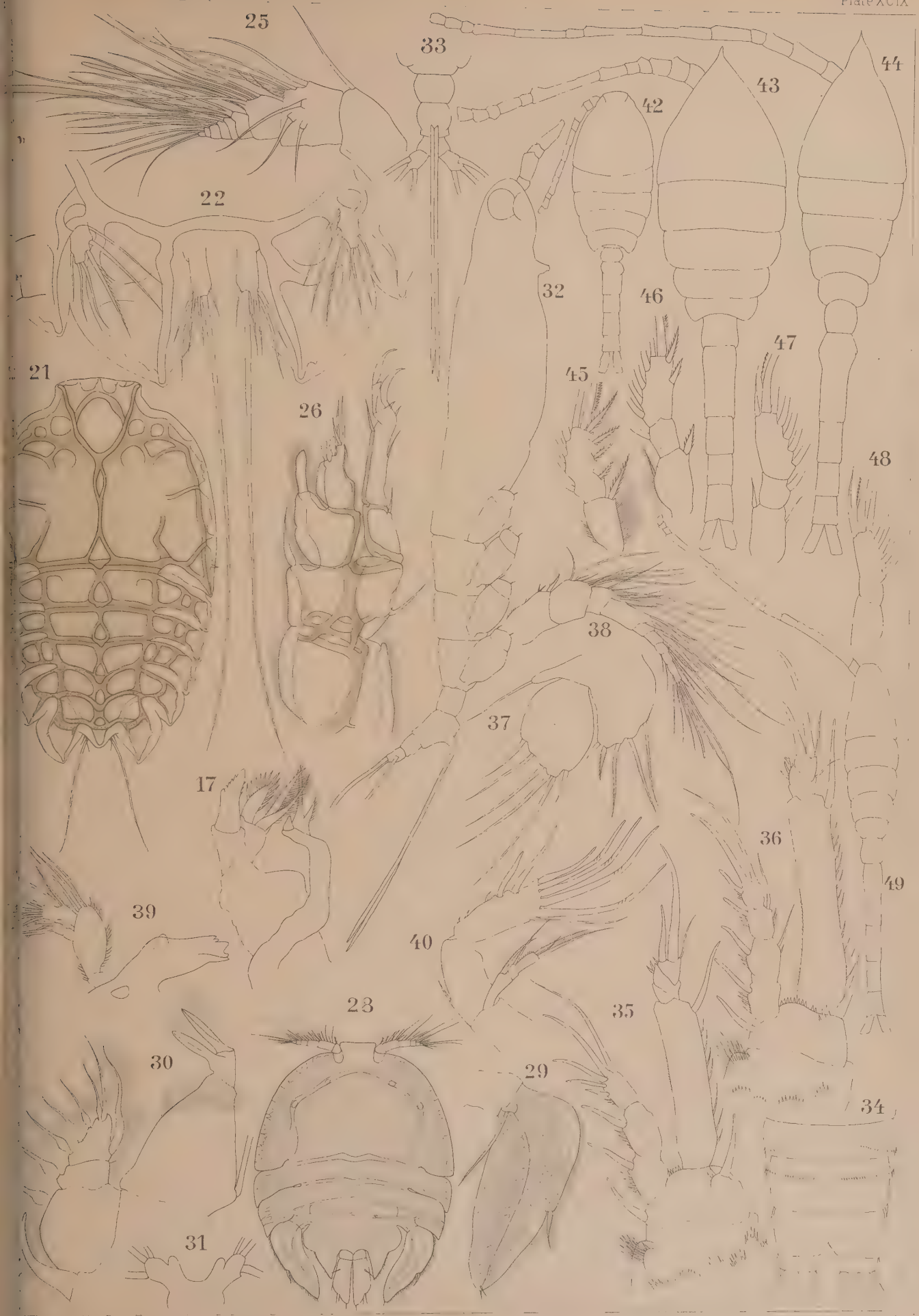

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CHILOPODA AND DIPLOPODA[1].

By R. I. Pocock, F.L.S., F.Z.S., *Superintendent of the Zoological Society's Gardens; formerly Assistant in the Zoological Department of the British Museum.*

(With Text-figure 154.)

The Chilopoda collected by Mr Stanley Gardiner are referable to five species. Three, namely *Rhysida longipes*, *Mecistocephalus punctifrons*, and *Orphnaeus brevilabiatus*, are widely distributed. The fourth, *Lithobius sculpturatus*, has hitherto been recorded only from the hill country of Southern India. The fifth, which is described with hesitancy as new, is closely related to a form found in the Cameroons and not as yet procured elsewhere. Of these the one that has the greatest bearing upon the origin of the fauna of the Maldives and Laccadives is *Lithobius sculpturatus*. This little centipede is not a frequenter of human habitations and therefore probably owes its presence in the islands to other than human agency. Hence it seems also probable that the remaining elements of the chilopod fauna were not transported thither by man; and this conclusion is fortified by the absence of such common forms as *Rhombocephalus morsicans* and *subspinipes*, which accompany civilised man almost everywhere in his wanderings within the tropics.

Of the two species of Diplopods, both of which are described as new, one only, namely, *Trigoniulus scaphurus*, was met with in any abundance. Neither gives a clue to the origin of the fauna of the Archipelagoes. But as in the case of the two species of *Rhombocephalus* mentioned above, it is very significant that two millipedes, namely *Trigoniulus goësi* and *Orthomorpha gracilis*, which are notorious importations in connection with human commerce within tropical and temperate zones, appear to be unrepresented in the islands.

Class Chilopoda.

Order **Lithobiomorpha.**

Genus *Lithobius*, Leach.

1. *Lithobius sculpturatus*, Poc.

Ann. Mag. Nat. Hist. (7), viii. p. 449, 1901.

Locality. Minikoi; Madu in S. Mahlosmadulu; Midu, Addu Atoll; Hulule in Male Atoll.

Previously recorded and hitherto known only from Madras and the Palni Hills in S. India.

This species resembles the Seychelles form *L. seychellarum* Brölemann in the number of ocelli and of antennal segments and in the rugosity of the tergites, but differs in the presence of 3 + 3 spurs on the genital forceps in the female and in the absence of angulation upon the posterior border of the 9th, 11th and 13th tergal plates.

[1] I received this paper in February, 1905. I regret that it has been unavoidably delayed. Ed.

Order **Scolopendromorpha.**

Genus *Rhysida*, Wood.

2. *Rhysida longipes*, (Newp.).

Branchiostoma longipes, Newp., *Trans. Linn. Soc.* XIX. p. 411, 1845; Haase, *Abh. Mus. Dresden*, No. 5, p. 83, 1887 (and subsequent authors).

Locality. Minikoi; Goidu, Fainu, N. Mahlosmadulu; Madu, Mahrus, S. Mahlosmadulu, Midu, Addu; Hulule, N. Male; Maungudu, Miladumadulu.

Widely distributed in the Oriental Region and thence exported, perhaps by the agency of commerce, to tropical countries of both hemispheres.

Order **Geophilomorpha.**

Genus *Mecistocephalus*, Newp.

3. *Mecistocephalus punctifrons*, Newp.

Newport, *P.Z.S.* 1842, p. 179; *Tr. Linn. Soc. Zool.* XIX. p. 429, 1845; Haase, *Abh. Mus. Dresden*, No. 5, p. 104, 1887 (and subsequent authors).

Locality. Minikoi; Fainu, Inguradu, N. Mahlosmadulu; Mahrus, Madu, S. Mahlosmadulu; Maungudu, Miladumadulu.

Abundant and of wide distribution in the Oriental Region and exported thence to other tropical countries.

Genus *Orphnaeus*, Meinert.

4. *Orphnæus brevilabiatus*, (Newp.).

Geophilus brevilabiatus, Newport, *Trans. Linn. Soc. Zool.* XIX. p. 436, 1845.

Orphnaeus brevilabiatus, Haase, *Abh. Mus. Dresden*, No. 5, p. 111, 1887 (and subsequent authors).

Locality. Kenurus, N. Mahlosmadulu; Mafaro, Miladumadulu; Hulule, Male Atoll.

Common in the tropics of both eastern and western hemispheres.

Genus *Ballophilus*, Cook.

Geophilus, Porat, *Bih. Sv. Vet.-Akad. Handl.* XX. Pt. IV. No. 5, p. 25 (*maculosus*).

Ballophilus, Cook, *Proc. U.S. Nat. Mus.* XVIII. p. 69, 1895; *id. Brandtia*, VIII. p. 36, 1896.

Thalthybius, Attems, *Zool. Jahrb. Syst.* XIII. p. 139, 1900.

5. *Ballophilus maldivensis*, n. sp. (?).

Body anteriorly attenuated, beset with stiffened bristles.

Colour sandy yellow; head and first two tergal plates tinted with reddish brown; a black patch suffusing the porous area of the sterna. Antennae geniculate, with the terminal six segments expanded, the penultimate and antepenultimate about four times as wide as long; the apical scarcely longer than wide, semielliptical, with apex narrowed, as long as the two preceding segments; segments in basal half scarcely longer than wide. *Head* shining, very finely coriaceous, about half the length of the antennae. Basal plate and tergum of first leg-bearing

somite also nearly smooth and shining, the former from three to four times as wide as long. The rest of the terga and preterga coarsely coriaceous and tubercular, the tubercles arranged in transverse rows; no tergal sulci. Sterna coarsely coriaceous and tubercular, the tubercles less numerous than on the terga and arranged as a rule in four longitudinal rows, one consisting of three tubercles near the margins, and two of two each on the area in front of the porous elevation. The latter transversely oval on the anterior and median sterna but becoming more circular at the posterior end of the body. The last tergite posteriorly narrowed, its anterior width much exceeding its posterior width and about equal to its length. Last sternite also posteriorly narrowed, its surface irregularly tumid.

Number of pairs of legs, 67.

Length, 21 mm.

Locality. Maldive Islands: Midu, Addu Atoll.

Two species of the genus *Ballophilus* have been previously recorded, namely, *B. maculosus*, Porat (*Bih. Sv. Vet.-Akad. Handl.* xx. Pt. iv. No. 5, p. 25, Pl. i. fig. 2, 2 *b*, 1894) from the Cameroons, and *B. clavicornis*, Cook (*Brandtia*, viii. p. 37, 1896) from Liberia and Togo, both, that is to say, from tropical West Africa. It is probable however that these two are in reality identical, as Cook himself suggested; while at the same time he pointed out that Porat must in that case have overlooked the very large pleural pores visible in *B. clavicornis*. That would not be a remarkable fact, seeing that the pores are concealed under the minute last sternum. The second distinction Cook urges in support of the claims of his species is the presence of 63 to 73 pairs of legs as compared with the 77 pairs ascribed to *B. maculosus*. The last mentioned number must, however, be regarded as doubtful since in the synopsis of species on p. 22, Porat gives it as 71, proving a misprint in either one case or the other.

I am not at all satisfied that the Maldive specimen is specifically distinct from the West African ones described by Porat and Cook. The colour is perhaps paler. Cook states that in life *B. clavicornis* is fuliginous, violaceous or black; Porat's specimen was bluish-grey, but since, as Cook states, examples of his species sometimes faded to yellowish in alcohol, it would be rash to attach much importance to the pale yellowish colour of the Maldive example.

Again the antennae appear to be shorter in *B. maldivensis* than represented in Porat's figure of *B. maculosus*. In the latter they are nearly three times as long as the head; in the former they appear to be only about twice as long. But no great stress can be laid upon this problematical difference and practically the only claim to specific recognition the Maldive specimen has, is the wide difference in locality between it and the West African forms. Porat's Cameroon specimens were found in the tunnel of a termite's nest. Concerning the specimens discovered in Liberia, Cook remarks that "the unusually large and clavate antennae and anal legs seem to be correlated with a peculiar habit of throwing first one end of the body and then the other when disturbed, instead of crawling like other Chilopoda, this strange method of progression being swift and effective. *Ballophilus* is further protected by the unique colour, often nearly black, and always inconspicuous in the twilight of the deep forests to which it seems to be confined."

The species described by Attems as *Thalthybius melanostigma*, from Mahé in the Seychelles, appears to differ from those mentioned above in possessing a larger number of legs, namely 101 pairs. The colour is said to be pale olive green.

Class Diplopoda.

Order **Opisthospermophora.**

Family **Spirobolidae.**

Genus *Trigoniulus,* Poc.

6. *Trigoniulus scaphurus,* sp. n.

Colour blackish; head blackish brown with labral margin yellowish; antennae ochre, each segment with a patch of brown; first tergite black with narrow yellow anterior and posterior rim; remaining segments blackish, fading to brown inferiorly, the posterior border yellow, the yellow band broader and less well defined ventrally than dorsally; anal valves yellowish brown; legs ochre yellow. *Head* shining, nearly smooth; sulcus mesially obsolete. *Eyes* well defined forming a triangular cluster. *Antennae* slightly incrassate.

First tergite nearly smooth, acutely angular, with a blunt inferior apex, laterally.

Median *tergite* of body marked with a deep transverse groove, the area behind the groove elevated, punctate and striolate longitudinally; inferiorly striate; area in front of it punctulate and marked with semicircular or semielliptical impressions close to the groove, striolate laterally. *Pores* well behind the groove.

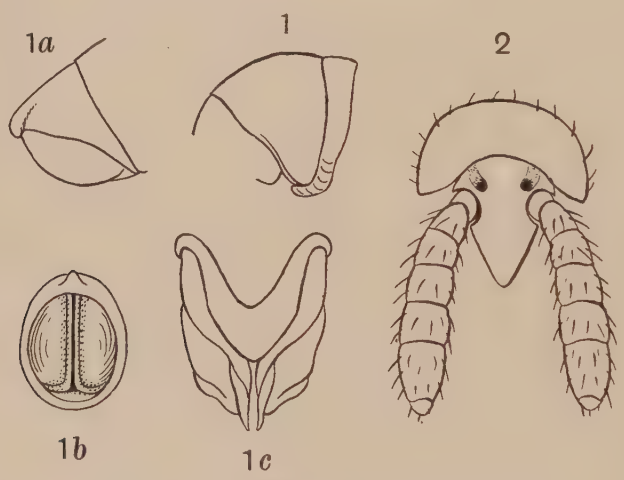

Fig. 154.

Fig. 1. *Trigoniulus scaphurus,* sp. n. Lateral view of first and second tergites.

Fig. 1 *a.* „ „ „ Lateral view of anal somite.

Fig. 1 *b.* „ „ „ Posterior view of anal somite.

Fig. 1 *c.* „ „ „ Anterior view of copulatory apparatus of male.

Fig. 2. *Siphonotus gardineri,* sp. n. Anterior view of head, antennae and first tergite.

Anal somite, tergite obtusely angular posteriorly; without a distinct caudal process, but with the median dorsal area of the posterior portion compressed to form a distinct carina. Anal valves with their margins strongly compressed, defined by a deep groove; but the area external and adjacent to the groove very strongly convex and projecting as far posteriorly

as the edges of the valves themselves, which are thus invisible from the lateral aspect. Sternite not angular; its posterior border transverse.

Copulatory organs of ♂ (fig. 1 *c*).

Number of segments, 38.

Length, 23 mm., width 1·8 (♀). Male shorter and thinner.

Locality. Minikoi; Midu, Addu Atoll; Goidu, Goifurfehendu Atoll; Madu, Maduwari, Hedufuri, South Mahlosmadulu; Fainu, North Mahlosmadulu.

Abundant everywhere.

The structure of the anal valves and the cariniform elevation of the anal tergite are peculiarities serving to distinguish this small species from others of the genus known to me.

Order **Colobognatha.**

Family **Polyzonidae.**

Genus *Siphonotus*, Brandt.

Siphonotus, Brandt, *Bull. Acad. St Petersb.* I. No. 23, p. 179, 1837; Pocock, in *Max Weber's Zool. Ergebnisse*, etc. (type *S. brasiliensis*, Brandt).

Rhinotus, Cook, *Ann. N. York Acad.* IX. p. 2, 1896 (type *Siphonotus africanus*, Cook).

Bdellotus, id. ibid (type *Siphonotus formosus*, Poc.).

Orsilochus, Attems, *Zool. Jahrb. Syst.* XIII. p. 166, 1900 (type *O. crassiceps*, Attems).

I think the above-given generic synonymy will prove to be correct, although Brandt's diagnosis of *Siphonotus* is not quite all that could be desired. It was the element of doubt on this point that served as a pretext for the proposal of the name *Rhinotus* for the Liberian species, *africanus*. The type of *Bdellotus*, namely *S. formosus* from Java, differs from that of *Rhinotus* apparently only in the greater width of the body as compared to its length—a specific character in the Colobognatha. The type of *Orsilochus*, namely *crassiceps* from the Seychelles, closely resembles *formosus* in this particular, the proportion being 1 : 10. It is singular that Attems restricted the comparison of his genus to *Polyzonium* and *Siphonophora*, apparently quite overlooking the claims of *Siphonotus*, *Rhinotus* and *Bdellotus* to be considered.

7. *Siphonotus gardineri*, sp. n.

Colour to the naked eye a uniform darker or lighter brown, in reality the tergal plates are yellowish with a varying quantity of underlying pigment; dorsal surface unstriped; legs and pleural plates entirely pale or weakly pigmented; antennae blackish brown, heavily pigmented; head mostly pale, weakly pigmented, except for a pair of large spots involving the eyes. *Head* long, much longer than its basal width. *Antennae* also long, when extended in a line with the snout, the latter reaching about to the distal end of the third segment. *Tergal plates* smooth polished, the transverse groove not sculptured. Number of segments, 49—53. Length up to 14 mm., width ·8 mm.

Locality. Laccadive Islands; Minikoi.

Three female examples.

NOTES ON THE DISTRIBUTION OF THE LAND AND MARINE ANIMALS, WITH A LIST OF THE LAND PLANTS AND SOME REMARKS ON THE CORAL REEFS.

By J. Stanley Gardiner, M.A., *Fellow of Gonville and Caius College, and Demonstrator of Animal Morphology in the University of Cambridge.*

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a. Concluding Remarks.

In concluding this Report I must in the first instance express my indebtedness to all those who have assisted me by the examination of different groups of animals and plants. This has been no light labour, since the investigation of many groups entailed much delicate microscopical work, and of others the sorting over of a great mass of material from many different localities, the bulk of it common and relatively uninteresting from a systematic point of view. The manual labour entailed was considerable, and I am indebted to Mr Adam Sedgwick for the hospitality of his laboratory. The insects were sorted and sent out for determination by Dr D. Sharp, while the Crustacea were taken in hand by Mr L. A. Borradaile, as a fine set of reports from his pen bear testimony.

The separate papers in the whole Report number 54 by 32 different authors. Most of them are necessarily systematic, but many are of especial value, as their authors have included revisions of the genera and families, morphological accounts, etc. Many are of wider interest, notably those of Mr R. C. Punnett on Variation in the Cephalochorda and Enteropneusta, groups of animals supposed to contain many ancestral features and of which we were fortunate enough to secure a large number of specimens. These particular

papers I consider, in opposition to certain critics, particularly suitable for such a publication as this is, since an accurate knowledge of the problems of variation, as far as they are known to biologists, lies at the basis of all systematic work.

With regard to the Index it has seemed to me most convenient to divide it into two parts. The first gives the genera with the species of each obtained, the whole in alphabetical order, a method which I have personally found most convenient when engaged in systematic work. The second is a general index dealing with the papers and authors, the more general subjects dealt with, and to a certain degree the families where they are treated of in relation to one another, or from a general point of view.

b. Further Notes on the Marine Fauna, with a List of the Algae.

The general problems relating to the distribution of marine animals and plants are still in their infancy. In many of the reports on the separate groups the distribution of the species has been added, but it has seldom been found possible to draw any deductions therefrom. The genera and species of marine animals dealt with number approximately 506 and 1352; of these 10 genera and 254 species are new. Moreover of the previously known forms, so far as I can estimate from certain groups, more than half have been obtained from less than two other localities, whereas we have reason to believe that a very large number of even these particular forms are of almost universal distribution throughout the Indian Ocean.

Deep-sea animals, living under more uniform conditions of light, temperature, motion, etc. can scarcely be supposed to aid us materially in the various questions relating to the former connections of lands, but shallow-water, littoral forms may well be of assistance. To this end we require further research on the bionomics and the bathymetrical distributions of such forms. We should know more of their free-swimming larvae, their power of being dispersed, or of continuing to live as larvae[1]. This knowledge can only be acquired gradually, and meantime we can profitably compare the faunas and floras of different localities. I had hoped to have attempted such a comparison of the Maldive marine fauna, but I was at once met with an extraordinary absence of knowledge of that of other coral reefs in the Indian Ocean, with which in the first instance, since their environment and biological conditions would probably be nearer to those of the Maldives and Laccadives, the comparison should be made. Under the circumstances it appeared to me advisable to defer any such comparison and to undertake a further expedition in 1905 to the western part of the Indian Ocean, so as to examine the faunas of these reefs and their slopes. Owing to the absence which this entailed and to illness, this Part has necessarily been delayed, but I hope in the results of this later expedition to deal fully with the Maldivan fauna in this connection.

In my account of the Coral Reefs of the region, I have dwelt at some length on the interrelations of the marine animals, and I may under the circumstances defer any further account of them. I regret that no reports should have been included on the Porifera, Actiniaria, Polyzoa, some of the Crustacea, Holothuriae, and Tunicata, but I hope that these blanks in the fauna may subsequently be filled up from the collections, which we secured.

[1] See "Notes and Observations on the Distribution of the Larvae of Marine Animals," by J. Stanley Gardiner, *Ann. Mag. Nat. Hist.* Ser. 7, Vol. xiv. p. 403, 1904.

The Polychaeta were intrusted to Mr Cyril Crossland, and accounts so far have been published in the *Proc. Zool. Soc. London*, 1904, Vol. I. of the following species:—

1. *Chaetopterus longimanus*, n. sp., p. 272.
2. „ *longipes*, n. sp., p. 277.
3. *Phyllochaetopterus aciculigerus*, n. sp., p. 278.
4. „ *gardineri*, n. sp., p. 280.
5. *Hyalinoecia camiguina*, Grube, p. 281.
6. *Onuphis holobranchiata*, Mar., p. 283.
7. *Lysidice collaris*, Grube, p. 284.
8. *Eunice aphroditois*, Pallas, p. 288.
9. „ *grubei*, Gravier, p. 288.
10. „ *afra*, Peters, p. 289.
11. „ *coccinea*, Grube, p. 297.
12. „ *murrayi*, McIntosh, p. 310.
13. „ *antennata*, Sad, p. 312.
14. „ *indica*, Kby, p. 318.
15. „ *siciliensis*, Grube, p. 323.

As the Marine Fauna depends largely on the flora I append a list of seaweeds from a paper by Miss Barton (Mrs Anthony Gepp) in the *Linnean Society's Journal, Botany*, Vol. xxxv. p. 475.

1. *Ulva*, sp. ?
2. *Caulerpa freycinetii*, Agh.
3. *Halimeda tuna*, Lamx.
4. „ *opuntia*, Lamx.
5. „ *incrassata*, Lamx.
6. *Valonia convervoides*, Harv.
7. *Sargassum duplicatum*, Agh.
8. *Turbinaria decurrens*, Bory.
9. „ *ornata*, J. Agh.
10. *Haliseris delicatula*, Agh.
11. *Dictyota bartayresiana*, Lamx.
12. *Balfsia verrucosa*, Aresch.
13. „ *ceylanica*, Harv.
14. *Liebmannia laccadivarum*, n. sp.
15. *Hydroclathrus cancellatus*, Bory.
16. *Colpomenia sinuosa*, Derb. et Sol.
17. *Ectocarpus simpliciusculus*, Agh.
18. „ *spongiosus*, Dickie.
19. *Galaxaura rugosa*, Lamx.
20. *Gelidium rigidum*, J. Agh.
21. *Gracilaria crassa*, Harv.
22. *Laurencia*, sp. ?
23. *Spiridia aculeata*, J. Agh.
24. *Halymenia formosa*, Harv.
25. „ sp. ?
26. *Peyssonellia rubra*, J. Agh.
27. *Corallina*, sp. ?

The Madreporaria are unfortunately left incomplete, the Perforata and Pocilloporidae not having as yet been specifically determined. However, four forms of *Goniopora* (G. Maldives (4) 1—4 = *G. maldivium prima—quarta*) have been described by Mr H. M. Bernard in the

Brit. Mus. Catalogue of Corals, Vol. IV. p. 86, et seq. and *Coenopsammia willeyi*, *C. nigrescens*, and *Dendrophyllia ramea* were determined in connection with work on their pigments. Specimens of *Heliopora coerulea*, *Tubipora musica* and *Millepora albicornis* were not sent out for identification.

c. The Land Animals, with Notes on their Habits and Distribution.

The mammals are represented by three species only, identified by Mr Oldfield Thomas as follows:—

1. *Pteropus medius* Temm. The Flying Fox, found all over India.
2. *Crocidura murina* Linn. The Common Musk Shrew of India and Malaysia.
3. *Mus rattus alexandrinus* Geoff. The Common Tree and Ship Rat, found all over the world.

Of these the big fruit bat (1) is the only mammal which can be properly called indigenous. Insectivorous bats might reasonably be expected, but none such at present occur in the groups. The rat (3) commits great ravages, ascending the tallest coco trees and boring into the nuts, when still green. The shrew (2) is local, rare in Addu and Suvadiva. It feeds on the roots of plants and broken coconuts but does not ascend the trees.

The flying fox is ubiquitous in the Maldives, but does not occur in Minikoi. Wherever a banyan tree grows, numbers of these bats may be found clinging to its branches. They rarely rest on other trees, preferring to undertake nightly migrations for food. At Limbo-Kandu (centre of the N. Mahlos Atoll) they commenced to disperse about 6 p.m., going to every island of its atoll. Coming singly out of the trees, each set off by itself on a straight course, continued as far as the eye could see. They could be heard returning in the darkness of the late hours of the night, only a few belated travellers being seen at dawn. The single journey must have been in some cases 15 to 20 miles, and even this was exceeded in parts of Miladumadulu. The same phenomenon was observed regularly at Hulule, the dispersal taking place night after night during the half-hour before sunset, however clouded the weather might be. Their food consists principally of the fruits of the *Zizyphus*, *Terminalia*, *Calophyllum*, and Banyan, but breadfruit and *Pandanus* are also largely consumed; in times of stress the buds and centres of the last two are eaten. Many were seen with young in April, this being according to the natives a regular season for births.

Amphibia and Reptiles number respectively 2 and 11. *Rana tigrina* inhabits the low planting land at Minikoi, and is stated to have been introduced, when the present lighthouse was built. *Bufo melanostictus* inhabits bathing tanks and pools, often of very brackish water, in Male, Hulule, and Addu Atoll; it is never killed, and was probably introduced in drinking water. Of lizards *Calotes versicolor* is seen in every graveyard in the Maldives, but is unknown in Minikoi; the race appeared to be markedly smaller than in Ceylon and S. India. Geckoes (*Hemidactylus frenatus*) and skinks (*Lygosoma albopunctatum*) are scarce, being found only under bark and decaying vegetable matter; this is due probably to the abundance of rats, which eat them. The blind snake (*Typhlops bramineus*) is evidently rare, as it was never recognised by the natives, when shown to them. It lives in decaying humus, moving with great rapidity, and burrowing when exposed to the light. Of the other snakes *Aspidura trachyprocta* is a recent introduction to Male Island, but *Lycodon aulicus* is known to all the people of Tiladumati and to many in the central atolls; it does not apparently occur in Suvadiva or in Addu. Its habitat is among the branches of the small species of *Pandanus*,

or screw pine. The sea snake (*Hydrus platurus*) gets progressively rarer from north to south, and is never found in schools as off Ceylon. The tortoise (*Nicoria trijuga*) has certainly been introduced intentionally into many bathing tanks and pools from Ceylon. The young turtles (*Chelone mydas* and *C. imbricata*) are also kept in the same pools. Neither are eaten as they "suckled Komburani, when he hauled up the islands from the deep with his fish-hook." In Addu I saw the remains of a *Spargis*, a single animal regarded as a great curiosity, having come ashore about 10 years before our visit.

The freshwater fish number six and there are two prawns (*Leander debilis* and *gardineri*). Some of them are marine forms, which live equally well in freshwater, and the others have almost certainly evolved their peculiar characteristics from marine ancestors, quite independently of any other localities where they occur.

Of the Crustacea the land Decapods have special means of dispersal by marine larvae, and indeed should almost be treated as marine forms, so far as distribution is concerned. Isopods as well as land Molluscs largely live on decaying vegetable and animal matter, and may have well been introduced with plants. The new species described are either Indian or Ceylon forms, or modifications of the same brought out by change of environment. The same is in the main true of the Myriapoda and Arachnida. All these are forms with relatively large yolked eggs and without any larval stages. They are all likewise able to adapt themselves to a rather varied diet, and so long as they reach a land with animals and plants of some sort may reasonably be expected to survive.

How the above animals reached the Maldives is of course uncertain, but generally speaking they are all such as might have reached the group by natural agencies in the north-east monsoon from India and Ceylon. Some may have been brought by man, but the natives confine their humanitarian tendencies to vertebrates, and take great care not to introduce pests. All may have indeed arrived on floating timber, numerous trees being swept off the coasts of India and Ceylon consequent on the erosion of their lands. These trees are often killed by the approach of the sea long before they fall, and are frequently swept off to sea in a single gale. Having much dead wood, generally considerable parts are unsubmerged, and even in the strongest gales are not more than wetted by the spray. Accordingly, it is by no means difficult to imagine how the Maldives may have become peopled by any of the above crawling and creeping forms, including even the snakes and the lizards. The fauna of the various atolls supports such a view of immigration, being decidedly more restricted to the south. At first sight there might perhaps be expected to be more peculiar or new species. But on consideration this would be hardly likely, since the timber, etc. carried over by the currents is generally that of the coasts (and not of the river banks) and would have been living with its numerous inhabitants in a closely similar environment to that on which the latter would land in the Maldives. To this similarity in the environment rather than to interbreeding with occasionally typical forms from the mainland, I would ascribe the lack of variation of that type, which produces new species, and which might naturally be looked for in a new locality.

The insects belong to a group by themselves since, except by man's agency, few are likely to have arrived as adults save by means of their power of flight. In their period of life as eggs, larvae, or pupae they might, it is true, be transported, but in most cases imago would have emerged to perish in the sea before sighting land. Furthermore, in these

conditions, or as merely young forms, they are more susceptible to sea-water than any of the forms treated above, even frogs and lizards. Again, insects are by no means adaptable to new environments. They are not carnivorous, and are not indifferent as to the quality and composition of decaying matter. Most indeed feed on the tissues or direct products in each case of some particular living plant, so much so that the whole insect fauna of any locality cannot properly be considered without a complete knowledge of the flora—and to some degree of the interrelationships of the individual species. However, so far as this fauna is concerned, there is no reason to suppose that it shows any relationships differing from those of other groups of animals.

Of the insects described 108 were obtained at Minikoi alone and 56 in the Maldives, while 42 were common to the two localities. Minikoi was the largest island visited; it was too the nearest to India, whose hills and coasts the north-east monsoon would directly sweep for its benefit. Lastly, the time spent there was thirteen weeks from June to September in the south-west or wet monsoon. The southern half, where we camped, is covered with a dense jungle of *Pandanus, Hibiscus, Ricinus, Scaevola* and *Tournefortia,* with the coconut rearing its head over all. Across the island were two rides. The one was by an old Muslim shrine, grass covered, but fringed by *Pemphis* with its sweet-smelling blooms, a source of great attraction to Hymenoptera and flies. The other was a clearing about 80 yards broad from the sea to the lagoon, serving as an open space around the lighthouse. Little grass grew on it, but the whole surface was green from various small flowered, herbaceous plants. This clearing was essentially the centre of insect life—doubtless the lighthouse as well had some effect—a few turns with the sweep-net generally producing more insects and a greater variety than a whole day on any island of the Maldives. A noticeable feature on sunny days was the comparative absence of all insects, but more particularly of Hymenoptera, between about noon and 3 p.m. During the morning there was a continuous hum, which gave place about midday to a dead silence. Few insects could be caught in the net in the early hours of the afternoon, but a flush came on about 3.30, all retiring again about 5 p.m.

Doubtless Minikoi was better collected than any single place in the Maldives, but it was the dry monsoon in the latter group. November and December when we were in Mahlosmadulu and Miladumadulu were quite dry, but heavy rain fell in January, when we were in residence at Hulule, Male Atoll. This produced a flush of insects, but there were neither a great variety of plants in this island nor any open rides. Hulule too is only one-sixth the size of Minikoi, but there was in reality a marked decrease in number and variety of insects in the whole Maldive group from north to south.

Examining the different groups of insects, of the dragon-flies *Rhyothemis variegata* and *Trithemis trivialis* were found everywhere, the former affecting the shores and open, dry places and the latter the forest glades. *Orthetrum sabinum* was perhaps introduced in water brought from Ceylon, when Minikoi lighthouse was built, living only in its vicinity. *Enalagma maldivensis* is the common Maldive form. *Zyscomena petrolatum* and *Pantala flavescens* were seen in Hulule alone, and may have been carried over from Ceylon by the heavy north-north-east winds of January.

The Lepidoptera alone show an excess of species, belonging to a single locality, from Hulule (25) over Minikoi (21), 20 being common to both islands. Several are distinctly referable to cultivated plants at Hulule, while the single specimens of *Vannessa cardui,*

Anosia plexippus and *A. montana* were probably brought down by the January winds from the continent, having apparently no food plants in the locality. Our collections from the northern atolls were ruined by a heavy sea, which broke over our schooner. *Ascotis bourmana*, which we did not obtain in Hulule, was common throughout Mahlos and Miladumadulu.

The Orthoptera were doubtless much enriched at Minikoi by the materials brought for the building of the lighthouse, 12 or half of the species coming from Minikoi alone. Locusts and grasshoppers, being strong fliers, scatter far and wide. The Mantis (*Hierodula simulacrum*), unknown in the Maldives, was interesting, its young having been found only on the *Hibiscus* around the pools at Minikoi used for soaking the coconut husks, preparatory to cord or rope making, while the adults wander all over the island.

To the Hymenoptera I add the following species of ants determined by Colonel Bingham :—

1. *Camponotus compressus*, Fabr. Hulule.
2. *Camponotus mitis*, Smith, var. *pacchus*, Smith. Mamaduwari, S. Mahlosmadulu.
3. *Camponotus pallidus*, Smith. Minikoi.
4. *Pheidole indica*, Mayr. Minikoi. A single specimen of a local variety of the species.

The fact that sixteen species of the group are described as new is probably due to the Indian and Ceylon forms not having been properly investigated, the already known forms belonging also to those localities.

Considered in its entirety the land fauna can only be stated to bear out the conclusions we reached before from the study of the geology, that the Maldives and Laccadives are recent lands; at the present time they are probably only being gradually peopled by animals and plants. As might be expected, the affinities of their land fauna are with India, but one might reasonably have expected some small degrees of relationships to be shown with Africa, Arabia, and Malaysia. Formerly there was constant intercourse in Maldivan, Malayan and Arabian bottoms with the great lands to the east and west, and yet we cannot lay our hands on a single form, which, not being ubiquitous, we can claim as belonging to either. Introduction by natural (not human) means of transport is, I am disposed to believe, much underestimated, and by human agency as much overestimated. In any case it is obvious that the distance, in spite of the favouring monsoons, is altogether too great even for a single species of animal to be carried over the great seas to the east and west of the Maldives, while of course winds and currents are unsuitable for any transport from more southerly lands.

d. The Land Plants of the Maldives.

The land plants were carefully collected and pressed in view of their distribution, economic uses, etc. and appear to belong to 284 species. The following list and table is taken from "The Botany of the Maldive Islands," by J. C. Willis and J. Stanley Gardiner, *Annals of the Royal Botanic Gardens, Peredeniya*, Vol. I. Pt. 2, pp. 1—120, 1901. In the same paper will also be found "Notes on the Vegetation of the various Atolls," pp. 69—82 and a discussion of "The Origin of the Flora."

The following is a list of the species identified by Mr Willis; cultivated forms are marked by a star.

**Artabotrys odoratissimus* Br.
**Anona muricata* L.
* „ *squamosa* L.
Tinospora cordifolia Miers.
Argemone mexicana L.
Brassica juncea Hk. f. & Th.
Cleome viscosa L.
Gynandropsis pentaphylla DC.
Polygala erioptera DC.
Portulaca oleracea L.
„ *quadrifida* L.
„ *tuberosa* Trim.
Calophyllum inophyllum L.
Sida humilis Willd.
„ *carpinifolia* L.
Abutilon indicum G. Don.
Hibiscus solandra L'Herit.
„ *tiliaceus* L.
„ *abelmoschus* L.
* „ *rosa-sinensis* L.
Thespesia populnea Corr.
**Gossypium herbaceum* L.
* „ *barbadense* L.
Adansonia digitata L.
**Abroma augusta* L.
Corchorus capsularis L.
„ *acutangulus* Lam.
Tribulus terrestris L.
**Averrhoa carambola* L.
* „ *bilimbi* L.
**Murraya koenigii* Spreng.
Triphasia trifoliata DC.
**Citrus medica* L.
* „ *aurantium* L.
* „ *decumana* L.
Suriana maritima L.
**Azadirachta indica* A. Juss.
Zizyphus jujuba Lam.
„ sp. ?
Colubrina asiatica Brongn.
Vitis linnaei Wall.
Cardiospermum helicacabum L.
Allophylus cobbe Bl.
Dodonaea viscosa L.
**Mangifera indica* L.
**Moringa pterygosperma* Gaertn.
Crotalaria retusa L.
Indigofera tinctoria L.
Tephrosia tenuis Wall.
„ *purpurea* Pers.
Desmodium umbellatum DC.
„ *gangeticum* DC.
„ *triflorum* DC.
Erythrina indica L.
**Canavalia ensiformis* DC.
Canavalia lineata DC.
**Phaseolus lunatus* L.
Vigna lutea A. Gray.
**Pachyrhizus angulatus* Rich.
**Clitoria ternatea* L.
**Dolichos lablab* L.
Sophora tomentosa L.
Caesalpina bonducella Fleming.
„ *bonduc* Roxb.
* „ *pulcherrima* Sw.
**Poinciana regia* Boj.
Cassia occidentalis L.
„ *sophera* L.
„ *tora* L.
„ *auriculata* L.
„ *glauca* Lam.
**Tamarindus indica* L.
**Parkia* sp. ?
Adenanthera pavonina L.
Mimosa pudica L.
Acacia farnesiana Willd.
**Rosa* sp. ?
Bryophyllum calycinum Salisb.
Rhizophora mucronata Lam.
Bruguiera caryophylloides Blume.
Terminalia catappa L.
Lumnitzera racemosa Willd.
„ *coccinea* W. & A.
Gyrocarpus jacquini Roxb.
**Psidium guyava* L.
**Eugenia malaccensis* L.
* „ *jambos* L.
* „ *javanica* Lamk.
* „ *jambolana* Lamk.
Barringtonia speciosa Forst.
Pemphis acidula Forst.
**Lawsonia alba* Lam.
Sonneratia acida Linn. f.
**Punica granatum* L.
**Passiflora coerulea* L.
**Carica papaya* L.
**Trichosanthes cucumerina* L.
**Benicasa cerifera* Savi.
**Momordica charantia* L.
**Cucumis sativus* L.
**Citrullus colocynthis* Schrad.
* „ *vulgaris* Schrad.
**Cucurbita moschata* Duch.
„ ? *pepo* L.
„ ? *maxima* Duchesne.
Sesuvium postulacastrum L.
**Panax* sp. ?
**Aralia guilfoylei* F. von M.
Oldenlandia corymbosa L.
„ *umbellata* L.

Oldenlandia biflora L.
**Hamelia patens* Sw.
Guettarda speciosa L.
Morinda citrifolia L.
Spermacoce ocymoides Burm. f.
Vernonia cinerea Less.
Adenostemma viscosum Forst.
Ageratum conyzoides L.
Blumea membranacea DC.
Eclipta alba Hassk.
Wedelia biflora DC.
Tithonia diversifolia A. Gray.
Artemisia vulgaris L.
Emilia sonchifolia DC.
Lactuca polycephala Benth.
Launaea pinnatifida Cass.
Scaevola koenigii Vahl.
Ardisia humilis Vahl.
Chrysophyllum sp. ?
Mimusops elengi L.
**Jasminum sambac* Art.
* „ *auriculatum* Vahl.
* „ *grandiflorum* L.
**Thevetia neriifolia* Juss.
Ochrosia borbonica Gmel.
Vinca rosea L.
**Plumeria acutifolia* Poir.
Calotropis gigantea Br.
Cordia subcordata Lam.
Tournefortia argentea L. f.
Trichodesma zeylanicum Br.
Ipomaea grandiflora Lam.
* „ *batatas* Lam.
* „ *quamoclit* L.
„ *turpethum* Br.
„ *denticulata* Chois.
„ *biloba* Forsk.
Hewittia bicolor W. & A.
Convolvulus parviflorus Vahl.
Evolvulus alsinoides L.
**Solanum melongena* L.
Physalis minima L.
**Capsicum minimum* Roxb.
Datura fastuosa L.
* „ *suaveolens* H. & B.
**Nicotiana tabacum* L.
Herpestis monniera H. B. & K.
Ruellia ringens L.
Barleria prionitis L.
Justicia procumbens L.
Rungia parviflora Nees.
Lantana mixta L.
Lippia nodiflora Rich.
Stachytarpheta indica Vahl.
**Tectona grandis* L.
Premna integrifolia L.
Vitex negundo L.
Clerodendron inerme Gaertn.
Ocimum basilicum L.
„ *gratissimum* L.
„ *sanctum* L.
Plectranthus zeylanicus Benth.
Anisomeles ovata Br.
Leucas biflora Br.
„ *zeylanica* Br.
Boerhaavia diffusa L.
Mirabilis jalapa L.
**Bougainvillia spectabilis* Willd.
Pisonia aculeata L.
„ *morindaefolia* Br.
Celosia argentea L.
Amarantus spinosus L.
* „ *caudatus* L.
„ *gangeticus* L.
„ *viridis* L.
Nothosaerua brachiata Wight.
Aerua lanata Juss.
Achryanthes aspera L.
**Antigonon leptopus* H. & A.
**Piper betle* L.
* „ *nigrum* L.
Cassytha filiformis L.
Hernandia peltata Meissn.
**Pedilanthus tithymaloides* Poit.
Euphorbia atoto Forst.
„ *hypericifolia* L.
„ *pilulifera* L.
„ *thymifolia* L.
Agyneia bacciformis A. Juss.
Phyllanthus maderaspatensis L.
„ *urinaria* L.
„ *niruri* L.
* „ *distichus* Muell-Arg.
Glochidion ? littorale Forst.
**Croton tiglium* L.
**Manihot utilissima* Pohl.
Acalypha paniculata Miq.
„ *indica* L.
„ *fallax* Muell-Arg.
Trewia ? nudiflora L.
**Ricinus communis* L.
Ficus benghalensis L.
„ sp. ?
* „ *religiosa* L.
„ *retusa* L.
„ *infectoria* Roxb.
**Artocarpus incisa* L. f.
* „ *integrifolia* L.
Fleurya interrupta Gaud.
Pouzolzia indica Gaud.

Musa sapientum L.
Ananas sativus L.
Crinum asiaticum L.
Pancratium zeylanicum L.
„ sp. ?
Tacca pinnatifida Forst.
Dioscorea pentaphylla L.
* „ *alata* L.
* „ *fasciculata* Roxb.
* „ *globosa* Roxb.
* „ *rubella* Roxb.
* „ *purpurea* Roxb.
Asparagus racemosus Willd.
Gloriosa superba L.
Commelina benghalensis L.
„ *kurzii* Clarke.
„ sp. ?
Cyanotis cristata Schultes f.
Rhaeo discolor Hance.
Areca catechu L.
Cocos nucifera L.
Pandanus odoratissimus L. f.
„ sp. ? (*leram* ?)
„ sp. ?
Colocasia antiquorum Sch.
Alocasia indica Sch.
Raphidophora pertusa Sch.
Acorus calamus L.
Pycreus pumilus Nees.
„ *polystachyus* Beauv.
Cyperus sp. ?
Mariscus dregeanus Kunth.
„ *albescens* Gaud.
Fimbristylis spathacea Roth.
Cladium jamaicense Crantz.
Paspalum sanguinale Lamk.
Panicum miliaceum L.
Spinifex squarrosus L.
Oplismenus compositus Beauv.
Setaria italica Beauv.
Stenotaphrum complanatum Schrank.
Thuarea sarmentosa Pers.
Toysia pungens Willd.
Zea mays L.
Saccharum officinarum L.
Ischaemum ciliare Retz.
„ *muticum* L.
Apluda varia L.
Andropogon sorghum Brot.
* „ *squarrosus* L. f.
* „ *nardus* L.
Eleusine coracana Gaertn.
„ *aegyptiaca* Desf.
Eragrostis tenella R. & S.
Bambusa arundinacea Willd.
* „ *vulgaris* Schrad.
Cycas circinalis L.
Nephrolepis exaltata Sch.
Thamnopteris nidus L.
Nephrodium molle Desv.
Psilotum triquetrum Sw.
*3 species undetermined.

The following table gives a summary comparing the floras of the Chagos, the Maldives, Minikoi, and the Laccadives, and their modes of reaching these lands.

Mode of transport	Chagos	Maldives	Minikoi	Laccadives	Whole Flora	
Sea currents	14	39	29	22	43	73
Sea probably	7	27	10	11	30	
Birds	—	1	—	6	7	28
Birds probably	5	16	7	10	21	
Wind	7	4	2	2	11	13
Wind probably	—	—	—	2	2	
Total independent of man	33	87	48	53	114	
Man, unintentional	2	41	21	35	56	106
Man, probably	9	32	16	26	50	
Total wild flora	44	160	85	114	220	
Cultivated	4	98	40	32	110	139
Cultivated, probably	1	26	9	4	29	
Grand total	49	284	134	150	359	

e. Additional Notes on the Coral Reefs.

Since my accounts were written[1] Prof. Agassiz has added very largely to our knowledge of the region by his book "The Coral Reefs of the Maldives[2]," which also beautifully and adequately illustrates the scenery of the group. The two modes of investigation adopted were so different from one another that the two accounts require for each atoll to be read together.

Prof. Agassiz' criticism of my work is very fair and just, but he has not always understood my attitude, probably owing to a lack of clearness on my part. Certain views I put forward naturally require modification in detail on account of the great additions he has made to our knowledge. I had to do the best with the facts at my disposal, and these naturally fell far short of what I desired, particularly in respect to the topography of the central basin. With regard to some places and some points I inevitably fell into error, but I do not feel that my main contentions in Chapter VII. are affected. In the meantime I may reasonably defer further consideration until Prof. Agassiz has given his views on the evolution of the Maldive archipelago and the formation of coral reefs[3]. The question of the formation of the Maldives too is associated with that of the coral reefs to the south and west, which I have lately been investigating in H.M.S. Sealark[4].

I may perhaps be permitted here to clear up one or two misunderstandings on Prof. Agassiz' part[5]. He remarks (p. 50) that in both Male and N. Mahlosmadulu "as well as in others are many sandbanks and rings with varying depths, of from three to four feet on the rims to five or six fathoms." This is true, but my contention is that the vast majority of such banks in the more enclosed atolls are breaking down and not springing (i.e. growing) up. According to our dredgings the bottoms of the lagoons were remarkably smooth (not necessarily level) except near shoals, reefs and passages, and did not appear to have any upgrowing coral or other masses such as might be expected to form surface reefs in course of time.

Prof. Agassiz did not quite understand my view as to the agencies assisting in the formation of lagoons[6]. I made a special study of the action of boring and sand-feeding organisms on corals and reefs, showing how they break and grind down even large masses of rock into fine mud. I regarded this mud as important in preventing the growth of coral and other sedentary organisms on the floors of the atolls, and at the same time I stated my view that its outwash is an important and direct subsidiary cause of the formation of

[1] *Vide* pp. 1—50, 146—183, 313—346 and 376—423.

[2] *Memoirs Mus. Comp. Zool. Harvard*, Vol. xxix. 1903.

[3] Prof. Agassiz has I understand such a work in progress. I would recommend particularly a study of Prof. Agassiz' Introduction; of the accounts of his soundings, pp. 29—34; of Tiladumati, pp. 78—82, 93—99; of Ihavandifulu, pp. 100, 101; and of Addu, pp. 145—148.

[4] The results of this expedition are in course of preparation, and will be published in the *Transactions of the Linnean Society*.

[5] The misunderstanding is obvious on p. 62 of "The Coral Reefs of the Maldives," as I state that "the combined result of the two (cyclones) has been to reduce the island (Turadu) by more than the half of its former size" (p. 382), and do not ascribe its reduction in size to solution. On p. 73 the two statements quoted are easily reconcilable. To paraphrase and combine the two sentences, "the lagoon is increasing on all sides (i.e. round its whole circumference) at the expense of the encircling reefs (where they exist), but these rim reefs are at the same time everywhere growing together (at their ends, i.e. against the passages into the atoll) to form a single enclosing (or encircling) reef."

[6] *Vide* pp. 67, 108, 143, etc. The "Introduction" is correct, p. xxiii.

lagoons, the main cause being solution (pp. 322 and 334). I am now inclined to lay still more stress on the importance of this outwash of mud in suspension[1].

In some places I perhaps appear to lay too much stress on single observations and on comparisons of small areas on charts of different periods. But these observations and comparisons all appeared to point in the same direction, and, when taken cumulatively, must be of great weight in any consideration of the evolution of the group. In Addu I found, or rather believed I found, an atoll differing from the rest in the Maldives in respect to its lagoon. I *therefore* emphasised it, giving the facts as I had them, showing my difficulties and discussing my conclusions. I regarded Addu as a peculiarly weak spot for my theory of the formation of the group, and I find now that Prof. Agassiz[2], who is probably quite correct, does not apparently regard Addu as differing from the rest of the group in respect to its lagoon. It appeared to me, as I definitely stated (p. 321), doubtful whether the increase of the land on Addu reefs would decrease, or increase, the effective source of sediment for filling in its lagoon.

I had intended to describe Hulule, the south-east island of North Male, in all its features with some detail, as we spent five weeks on it, and worked out carefully the relations of the reef animals and plants to one another and to the reef. It seemed, however, superfluous after I had described Minikoi. The present island[3] is of sand formation, growing out to the north but washing away to the south-east and south. It lies to the south of a large faro, the velu or lagoon of which varies up to 8 fathoms in depth. To the south of it again lying absolutely on the boulder zone of the reef is a small island, Gadu, formed of coral rock (the left island in the two figures of Plate XVII., opposite p. 344). Its summit is about 3 feet above high tide at springs, and its rock shows in places large Madrepores in position of growth—none are overturned—many with unbroken tips to their branches. A careful consideration of all the factors led me to estimate its elevation at 14—15 feet, of which 8—9 is directly proved by the position of its subfossil corals above the low tide level. At present it is being eroded away by the tide, and is fringed by a low cliff of 2—4 feet, often overhanging above. To the south-west Gadu tails off into a rough area, thickly strewn with large pinnacles of the same rock, while along the east side of the faro opposite Hulule are six isolated series of pinnacles, all of which rise to the ordinary high tide level. All lie on the outer part of the sand flat within the boulder zone, thus quite back from the edge of the reef (see Plate XVII. fig. 2). Together with Gadu these pinnacles show the remains of a large island, which once covered at least the whole south end of the faro and of which Hulule is now merely the remains. The west or lagoon reef of Hulule so far as growth goes is stationary, but the east or seaward is everywhere growing outwards, its past extension being perhaps shown by the positions of the pinnacles. The south end is almost stationary on account of the strong current which sweeps round it into the atoll, and through the passage between North and South Male Atolls.

[1] *Vide* "The Origin of Coral Reefs as shown by the Maldives," *American Journal of Science*, Vol. xvi. 1903, p. 210, and "The Formation of Coral Reefs," *Nature*, Vol. 69, 1904, p. 371.

[2] *Vide* pp. 145—148.

[3] See Agassiz, p. 37, Pls. 10 and 11.

INDEX I.

LIST OF THE GENERA AND SPECIES OBTAINED, WITH REFERENCES TO SPECIAL POINTS.

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